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STAFF APPRAISAL REPORT

KOREA

METROPOLITAN REGION WATER SUPPLY PROJECT

January 11, 1985

Urban and Water Supply Division
East Asia and Pacific Projects Department

CURRENCY EQUIVALENTS
(As of November 1, 1984)

Currency unit	=	Won (W)
Won	=	0.00125
US$1.00	=	800 Won

FISCAL YEAR

January 1 to December 31

WEIGHTS AND MEASURES

meter (m)	=	3.28 feet
kilometer (km)	=	0.62 miles
square kilometer (sq km)	=	0.39 square miles
hectare (ha)	=	10,000 square meter
cubic meter (cu m)	=	264 US gallons
cubic meters per second (cu m/s)	=	22.82 million US gallons per day
Gigawatt hour (GWh)	=	1 million kilowatt hours (kWh)
liter (l)	=	0.26 US gallons
liters per capita per day (lpcd)	=	0.26 gallons per capita per day
milligrams per liter (mg/l)	=	parts per million (ppm)
metric ton (mt)	=	2,205 lb or 1 cubic meter of water
metric tons per day (mtpd)	=	2,205 lbs per day or 264 US gallons per day

ABBREVIATIONS AND ACRONYMS

ADB	=	Asian Development Bank
DRP	=	Design Review Panel
EPB	=	Economic Planning Board
ERR	=	Economic Rate of Return
ICB	=	International Competitive Bidding
IMC	=	Inter-Ministerial Committee
ISWACO	=	Industrial Sites and Water Resources Development Corporation
KDB	=	Korea Development Bank
KECC	=	Korea Engineering Consultants Corporation
KEPCO	=	Korea Electric Power Company
MOC	=	Ministry of Construction
MOF	=	Ministry of Finance
MOHA	=	Ministry of Home Affairs
MOHSA	=	Ministry of Health and Social Affairs
OECF	=	Overseas Economic Cooperation Fund of Japan
OOE	=	Office of the Environment
RCMA	=	MOC's Regional Construction and Management Agency
UNDP	=	United Nations Development Programme
WB	=	Water Bureau

KOREA

METROPOLITAN REGION WATER SUPPLY PROJECT 1/

Loan and Project Summary

Borrower: Republic of Korea

Beneficiary: Industrial Sites and Water Resources Development Corporation (ISWACO).

Amount: $95.0 million equivalent, including the capitalized front-end fee.

Terms: Repayable in 15 years with 3 years of grace, at the standard variable rate. ISWACO would bear the foreign exchange risk.

Project Description: The proposed project would provide 1.3 million metric tons per day (mtpd) of water to 25 municipalities around Seoul City and within the Metropolitan Region.1/ This would improve water service to about 5 million persons and provide the capacity to serve 1.1 million additional persons by 1991.

The project would extract water from the Han river, upstream of Seoul, to be treated in three treatment plants before distribution to the municipalities. The project includes two water intakes, three booster pumping stations, two treatment plants, some 175 km of pipes (1,000 to 2,400 mm in diameter) and 14 km of tunnels, and construction supervision. Studies would be carried out to improve the organization of water and sewerage services in the Metropolitan Region, to establish corporate planning within ISWACO and to set policies for bulk water tariffs at a national level.

On completion of the project, assets and debt service liabilities, plus a service charge of 0.05% p.a. would be transferred to ISWACO.

Risks: There are no special risks in the project. The Government has provided assurances that complementary works necessary to utilize the water produced by the project would be completed before the project is commissioned in 1988.

1/ The Metropolitan Region includes the capital city of Seoul, the special city of Incheon, and 38 other cities and towns, and many villages in the Gyeonggi Province.

Project Costs:	Local	Foreign	Total
		($ million)	
Civil Works	78.0	30.6	108.6
Materials and Equipment	26.2	46.2	72.4
Land & compensation	9.9	0	9.9
Eng. & Technical assistance	4.5	1.2	5.7
Base cost	118.6	78.0	196.6
Physical contingencies	11.9	7.8	19.7
Price contingencies	18.4	17.4	35.8
Total Project Cost /a	148.9	103.2	252.1
Interest during construction	-	14.0	14.0
Front-end fee	-	0.2	0.2
Total to be Financed	148.9	117.4	266.3
Financing Plan:			
IBRD	-	95.0	95.0
Government equity	148.9	22.4	171.3
Total Financing	148.9	117.4	266.3

Estimated Disbursements: Bank FY	1985	1986	1987	1988	1989	1990
Annual	0.2	10.7	25.0	33.0	25.0	1.1
Cumulative	0.2	10.9	35.9	68.9	93.9	95.0

Rate of Return: 14%.

Map: IBRD 18420.

/a Including duties and taxes estimated at $11.5 million equivalent.

KOREA

STAFF APPRAISAL REPORT

METROPOLITAN REGION WATER SUPPLY PROJECT

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This report is based on the findings of an Appraisal mission consisting of Messrs. C. Fernandez (Financial Analyst) and E. Fernando (Engineer) who visited Korea in June/July 1984. Mr. Suk-In Kang also participated in the mission. Ms. Elisabeth Hellman assisted in preparing the report.

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1. Metropolitan Region - Project Municipalities and Bulk Water Supply Systems (Map IBRD 18420)

I. WATER SUPPLY AND SANITATION SECTOR

Country Background

1.01 Korea's population in 1983 was 40 million. Its population density of almost 400 persons/sq km is one of the highest in the world; it is also one of the most urbanized of the developing countries. The overall population growth rate has decreased from 3% in 1960 to about 1.5% at present. The urban population in the 187 largest municipalities, which represents 60% of the total, has been increasing by 5% p.a. or about three times the estimated growth rate of the total population. By the end of the century, the population living in municipalities of more than 50,000 inhabitants is expected to include about 80% of the total population. This rapid urbanization, equivalent to doubling the urban population every 14 years, has stretched all urban services, especially water supply. Coupled with accelerated industrial growth and the relatively low priority given to the sector earlier, this has resulted in a decline in the quality of the environment and water shortages with rationing in many cities. Since the 1970s, the Government has given increased priority to social services, which has resulted in significant improvements in the water supply and sanitation sectors and contributed to improvements in public health. Waterborne diseases have declined steadily since 1971. The crude death rate declined from 13 to 7 per thousand persons between 1960-81, while life expectancy increased from 53 to 66 years in this period.

Sector Organization

1.02 There is no single agency in charge of overall planning and programming of the sector. At the Central Government level, four Ministries are directly involved in the sector with some overlapping responsibilities (Chart 1). The Ministry of Construction (MOC), the main agency for the sector, through its Water Resources and Urban Planning Bureaus, is responsible for the planning, design and construction of major water and sewerage works and for collecting hydrological data, issuing licenses for abstraction of water from the major rivers and planning multipurpose dams. The Industrial Sites and Water Resources Development Corporation (ISWACO), a semi-autonomous public corporation under MOC, is responsible for the operation of bulk water systems serving groups of municipalities and for the development of multipurpose dams. The Ministry of Home Affairs (MOHA), through its Local Finance Bureau, oversees the operation of municipal Water Bureaus (WBs), including the approval of bonds, loans and tariffs and the expansion of distribution and storage facilities. The WBs are semi-autonomous organizations, responsible for the design, construction and operation of water works under the municipal governments. They maintain separate budgets and accounts of revenues and expenditures. The Ministry of Health and Social Affairs (MOHSA) is responsible for setting standards, and controlling the quality of drinking water and for implementing rural water supply programs. The Office of the Environment (OOE), under MOHSA, sets standards for pollution control and regulates and coordinates pollution control activities. The OOE also has to approve, under powers vested in it by the Environmental Preservation Law, projects which have an important impact on the environment. Finally, the Economic Planning Board (EPB) sets guidelines for tariff increases through its Price Policy Bureau and allocates counterpart funds for MOC's foreign funded projects.

Sector Financing and Tariffs

1.03 Investments in production and distribution of bulk water supplies to municipalities under regional arrangements are financed by MOC budgets and foreign loans. Such projects after completion are handed over to ISWACO for operation and maintenance and ISWACO also assumes debt service liabilities. ISWACO bulk water tariffs are approved by MOC and EPB and are the same country-wide. About 25-40% of the investments by municipal WBs are financed by funds budgeted by MOC, and provided to the WBs as loans, at commercial rates, through the Korea Development Bank (KDB). The balance of investment funds required is provided by the WBs' internal generation (15-35%), by sales of municipal bonds (20-40%), and foreign loans. EPB provides guidelines for maximum annual tariff increases which reflect macroeconomic policies, and MOHA approves the water tariffs set by the municipalities. Although there is not an explicit tariff policy, water tariffs have generally been sufficient to cover operation, maintenance, debt service and some contribution to capital investments. In the rural sector, a successful rural water supply program, scheduled for completion in 1986, is being implemented with the provincial governments, the villages and MOHSA each financing one third of the costs. Sewerage is financed from municipal revenues and Government and foreign loans. Sewerage tariffs are presently levied in the three largest cities, with all cities scheduled to start levying sewerage tariffs, varying from 20-50% of water tariffs, from 1985.

Service Levels

1.04 About 55% of Korea's population was served by piped water in 1980, compared with 17% in 1960 and 33% in 1970. Service levels are better (83%) in larger cities, where high population densities and polluted aquifers leave no alternative to publicly supplied water. However, many municipalities suffer from restricted supply, water rationing and frequent low pressure. The quality of treated water is uneven. Water produced by municipal systems averages about 260 liters per capita per day (lpcd), of which about half is for industrial, commercial and government consumption. However, 20-50% of the water produced is unaccounted-for, with leakage being a major factor. In an effort to reduce water losses, many municipalities are now implementing leak detection and control programs, including rehabilitation of older distribution networks supported through two ongoing Bank-financed projects, (para. 1.09).

1.05 Only 8% of the dwellings use sewerage systems, the rest use septic tanks, privies and night soil collection systems. Most of the wastewater from residential and industrial premises is discharged untreated or partially treated into street drains. This, combined with high leakage and the possibility of infiltration, exposes distribution systems to the risk of contamination. Increased emphasis is now being given to sewerage and waste disposal (para. 1.06) which is resulting in some improvements. Seoul and Busan, the two largest cities, and several other municipalities have established combined sewerage systems and night soil treatment plants serving about one third of their populations. The OOE and the municipalities are also enforcing pollution control measures on industry and commerce in an effort to improve the quality of receiving waters and to clean up the environment.

Sector Development

1.06 Sector investments in 1983 prices increased from $218 million in the Third Plan (1972-76), to $530 million in the Fourth Plan (1977-81) and is forecast to reach $1,442 million for the Fifth Plan (1982-86), with about half being Government expenditures. Government objectives during the Fifth Plan include preservation of water quality, replacement of obsolete equipment, and expansion and construction of new sewerage and water supply systems and treatment plants. The target for 1986 is to increase the population served by piped water from 55% to 70%. Given the high rate of urban population growth, maintaining even the present coverage requires substantial investments. The Fifth Plan provides for a number of environmental pollution abatement measures including an Environmental Master Plan Study of the Han River Basin (completed in 1984), expansion of combined sewerage systems and the building of night soil and sewage treatment plants in some 100 cities and towns. Government plans to increase the percentage of population served by sewage treatment plants from 6% to 35% and sewage treatment capacity from 0.5 million metric tons per day (mtpd) to 8 million mtpd during the period 1980-1991. Sanitation investments in the Fifth Plan are estimated at $800 million in 1982 prices.

Sectoral Issues and Constraints

1.07 The main sectoral issues, on which a dialogue has been established with the Government through the first two water supply projects (Loans 2072-KO and 2350-KO), approved in 1981 and 1983 respectively, are summarized below:

(a) Financial. At present Korea does not have a well-developed system for mobilizing and allocating resources to the sector. Although water supply projects require lengthy construction periods and do not reach their full capacity until several years after commissioning, the investment funds available to most municipalities are short-term bonds, internal cash generation and annually approved Government contributions. This results in project investments with relatively short design horizons being favored, while high priority and more cost-effective, but longer-term investments are delayed for many years. This could be improved with the establishment of financial mechanisms (para. 1.09) that would give water bureaus access to long-term finance. The lack of financial criteria for setting WBs' tariffs and ISWACO's bulk water tariffs also creates uncertainty about their capacity to assume debt service liabilities and finance long-term project investments. On the other hand, some projects are financed by grants from Government even when they could generate sufficient revenues to service debts. ISWACO's bulk water tariffs for treated and raw water have a national impact and affect many municipalities. Assurances were obtained during negotiations that a country-wide study of the bulk water tariff policy for raw and treated water would be undertaken by ISWACO, in consultation with the Bank, and presented to the Bank for comments not later than June 30, 1986. This study would be implemented and financed by ISWACO in coordination with EPB and MOC.

(b) Deficient Organization of Interurban Areas. The WBs are generally well operated and maintained. However, municipal water systems are independently planned and operated even after growth has resulted in several contiguous municipalities becoming physically integrated. The main problem in

this regard is in the Metropolitan Region (para. 2.01). The Bank has advocated the establishment of a better organization (for example a Water Authority), for the Metropolitan Region. This would increase service efficiency, eliminate unfairness in the access to water or sewerage services, eliminate duplication of investments and reduce dependence on Government grants. An initiative has already been taken by MOHA which has engaged the Korea Public Administration Research Institute to prepare a feasibility study of the organization of water supply services country-wide, including the Metropolitan Region. This study would review the feasibility of establishing a Water Authority for this Region. After the feasibility study is completed in 1984, it would be submitted to the concerned Ministries and the Bank for discussion. The reorganization of water and sewerage services is a sensitive political issue, particularly for the largest municipalities in the Region. Quick decisions and changes should not therefore be expected. MOHA would, after consensus has been reached, have to undertake a detailed study to implement the conclusions of the feasibility study for the Metropolitan Region. Terms of Reference for these studies have been discussed with the Bank (details in Project File) and assurances have been obtained that these studies would be completed and would be made available to the Bank for comments not later than December 31, 1986.

(c) Fragmentation of Responsibilities. The fragmentation of responsibilities among four Ministries (Chart 1) has resulted in a lack of coordination in sector planning, leading to a duplication of efforts in certain areas and the neglect of other activities. This also results in difficulties in preparing or financing projects, and in imbalances between the expansion of production capacity and the construction of distribution facilities. An Inter-Ministerial Committee (IMC) was established under Loan 2072-KO to discuss these problems and improve coordination gradually (para. 1.10). It is expected that the work of IMC will be strengthened after the recent decision to include EPB in its deliberations.

(d) Scarce Water Resources. A major difference between Korea and many other countries is the lack of adequate water sources. Per capita surface water runoff is only about 1,700 cu m or about 40% and 12% of the respective values in Japan and the United States. Since two thirds of the annual precipitation of 1,160 mm occurs during the rainy season from July to September, increased water demand requires the construction of multipurpose dams to store water and regional water transmission systems. These regional systems require long transmission pipelines and expensive pumping. The cost of these regional systems is also increasing rapidly due to the shortage of suitable dam sites, increasing land compensation costs, and long transmission pipelines. It is now very important, therefore, to improve the planning and utilization of water resources, especially for the four largest rivers - Han, Nagdong, Geum and Yongsan - the basins of which contain 70% of the industry and urban population of Korea. These plans would include the implementation of water conservation programs in the municipalities, master plans for and controls over the allocation and use of water in the rivers and adequate pricing policies, close to the marginal cost, to discourage water wastage and help curtail water demand.

(e) Independent Water and Sewerage Organizations. Both at the central level in MOC, and at the municipal level, the responsibility for water and sewerage rests with two separate Bureaus. Increasing urban population and density, higher water consumption, and industrialization now require a large effort to improve sewerage services and reduce pollution. A better integration and planning of the two services has been recommended by the Bank to the IMC. Specific proposals by MOC and MOHA to achieve this are presently under consideration by Government.

(f) Air and Water Pollution. High population density, increased ownership of vehicles, the use of coal for heating and especially the wastes generated by Korea's rapid industrialization, result in a deterioration of air and water quality. The Government enacted the Environmental Preservation Law in 1981 and the OOE and the municipalities are starting countrywide programs for sewage treatment and control of industrial air and water pollution.

Bank Objectives and Lending in the Sector

1.08 The Bank's objectives in the sector are to: (a) promote adequate and reliable water and sanitation services and improved environmental conditions; (b) ensure that the benefits of water and sanitation reach the poor, by the extension of the coverage for these services and the implementation of affordable tariffs; (c) help strengthen sector institutions and improve their coordination; (d) develop a solid financial basis for the sector, including cost recovery through better pricing policies and access to long-term financing; and (e) optimize and improve the efficiency of the use of water resources. The Bank liaises closely with other international agencies supporting this sector, in particular with ADB (which is financing several sewerage works and some water supply works); OECF (which is financing several sewage treatment plants); and UNDP (which is assisting in pollution control programs).

1.09 Direct Bank involvement with the water supply sector in Korea is very recent. The First Water Supply Project (Loan 2072-KO, approved in 1981), is financing the expansion of the water supply systems in five cities (Daegu, Gwangju, Masan, Changweon and Jinhae). The project is being executed smoothly, and four cities have already completed their works. MOC has, based on information available on manpower in the water sector and on training needs, prepared a training program to be implemented in 1985-86 under this project. Additional training programs for the sector will be based on further studies envisaged under the current, ADB financed, Small Towns Water Supply Project. The Second Water Supply Project (Loan 2350-KO, approved in October 1983), is aimed at increasing water availability for municipalities in the Nagdong basin and is progressing satisfactorily. Both of these projects have contributed significantly to strengthening sector institutions and addressing some of the key constraints to sector development discussed in the previous paragraph. Programs to introduce accrual accounting using microcomputers, and to apply appropriate leakage control technology for WBs are being implemented under Loan 2350-KO. A study for the establishment of an Urban Fund to finance urban development including municipal water supply projects is being prepared under the Jeonju Regional Project (Loan 2388-KO approved in 1984).

1.10 As part of the sector dialogue and at the request of the Government, the Bank prepared, in late 1983, a paper analyzing recommendations to improve sector coordination which is being discussed by the IMC established under the First Water Supply Project. This is a complex issue that will take time to resolve. MOC and EPB have, during discussions on this project, agreed to play a more active role in the IMC, which would now be chaired by MOC's Director General of Water Resources. The proposed project would also allow the continuation of this dialogue with Government and the main sector institutions and the gradual implementation of sector reforms as explained in para. 1.07.

II. THE WATER DEMAND

The Metropolitan Region

2.01 The proposed project would provide raw and treated water in bulk to 25 municipalities in the Metropolitan Region situated in the northwest part of the country (Map IBRD 18420). The Metropolitan Region has an area of about 3,000 sq km, and includes the capital city of Seoul, the special city of Incheon (the first and fourth largest cities in Korea), and 38 other cities and towns, and many villages in the Gyeonggi Province. The population of the region was 15 million in 1983, or about 37% of the country's population (compared with 21% in 1960, Graph 2.1) of whom about 9.2 million lived in Seoul City. The population growth in the Region has been extremely high (4.9% p.a.) during the last 20 years, compared with the growth rate of 2.1% for the whole country with some cities growing at up to 20% p.a. (Table 2.1). The economy of the Metropolitan Region has grown very rapidly, with the gross regional product increasing by almost 13% p.a. in the 1970s. This was the result of the rapid growth of the industrial and mining sectors, and the expansion of services associated with the Central Government. The Government is making efforts to curtail rapid growth, especially in Seoul City, through inter alia fiscal incentives for decentralization and zoning limitations. Seoul City's growth has slowed down to 3% p.a., and other satellite municipalities, which are the focus of the Project, have been developed. The population of the 25 municipalities included in the proposed project (Annex 3) grew at 7.1% p.a. during the last 10 years, with four municipalities recording annual growth rates of over 10%.

2.02 The appraisal projections assume that Government's plans to slow down the growth of Seoul and of some cities in the Metropolitan Region would be achieved gradually, (see detailed population and demand projections in Annex 3). The population growth of the 27 municipalities, served by the proposed Project and the two existing regional water supply systems, which had a population of 12.9 million persons in 1983, is projected to slow down from 4.7% p.a. during the last 10 years to 3.1% between 1983-88, and 2.3% p.a. between 1989-96. Under alternative projections the Metropolitan Region could become one of the largest metropolises in the world with the population reaching 18 to 21 million by the end of the century.

Table 2.1: CHANGES IN POPULATION DISTRIBUTION IN THE METROPOLITAN REGION

Region	1960 Thousand persons	1960 %	1970 Thousand persons	1970 %	1980 Thousand persons	1980 %	Avg. Annual Growth Rate (%) 1961-70	Avg. Annual Growth Rate (%) 1971-80
Korea	25,770		32,240		38,120		2.3	1.7
Seoul City	2,445	47.0	5,433	62.2	8,367	62.9	8.3	4.4
Gyeonggi Province	2,750	53.0	3,297	37.8	4,935	37.1	1.8	4.1
Metropolitan Region total	5,195	100.0	8,730	100.0	13,302	100.0	5.3	4.3
Gyeonggi Province								
Incheon	402	7.7	634	7.3	1,085	8.2	4.7	5.5
Suweon	91	1.7	107	1.9	311	2.3	1.6	6.4
Seongnam	31	0.6	61	0.7	376	2.8	7.0	20.0
Euijeongbu	57	1.1	93	1.1	133	1.0	5.0	3.8
Anyang	32	0.6	91	1.0	254	1.9	11.0	10.8
Bucheon	62	1.2	72	0.8	221	1.7	1.5	11.9
Subtotal	675	12.9	1,118	12.8	2,380	17.9	5.2	7.9
Others	2,075	40.1	2,179	25.0	2,555	19.2	0.4	1.6

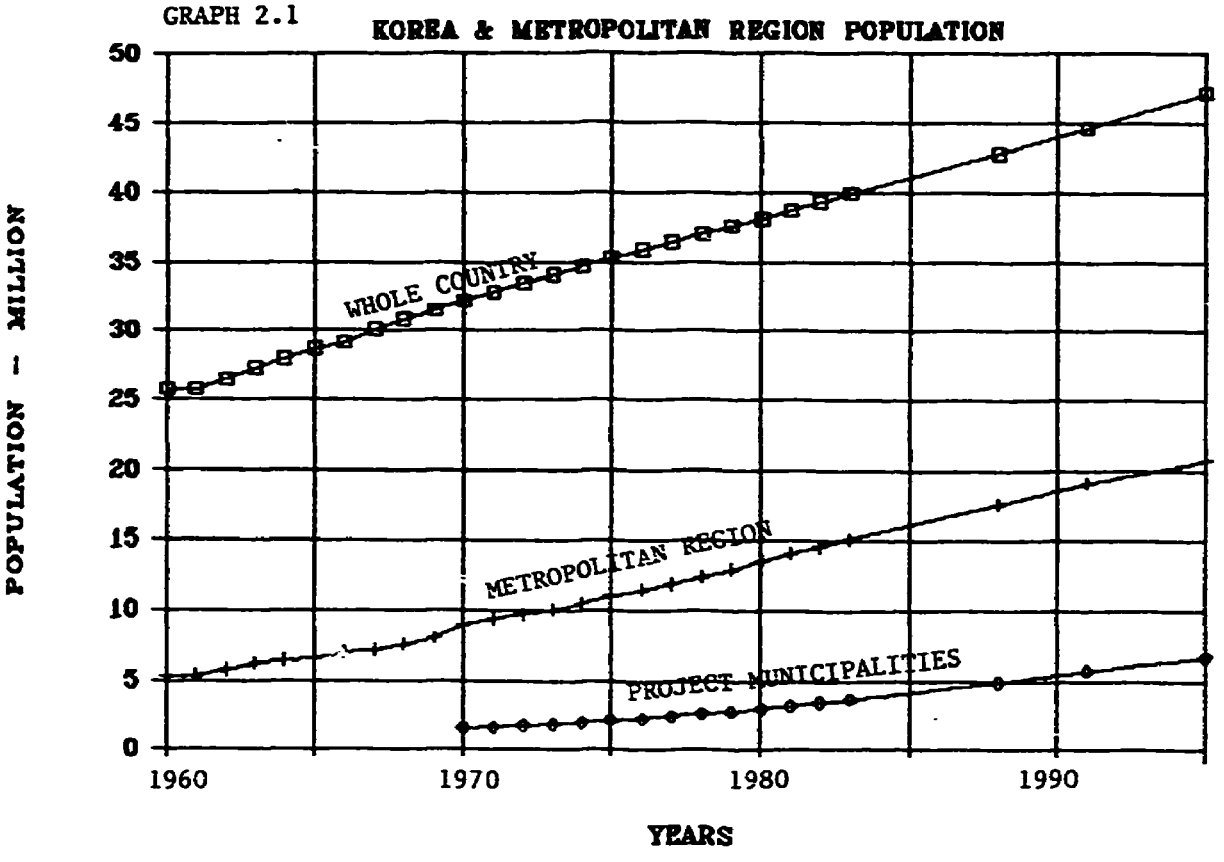
Levels of Service

2.03 Access to water services in the Metropolitan Region is uneven, with 96% of Seoul City but only 74% of the population in the other 39 cities and towns having house connections. Moreover, there are several towns and villages without piped water supply. The proposed project focuses on the municipalities around Seoul City [1/] which are less developed and poorer. Existing facilities and water supply statistics for 1981 and 1983 (water connections, volume produced and sold, distribution networks, tariffs and costs) for 40 cities and towns in the region are presented in Annex 1, with details in Tables 1, 2 and 3.

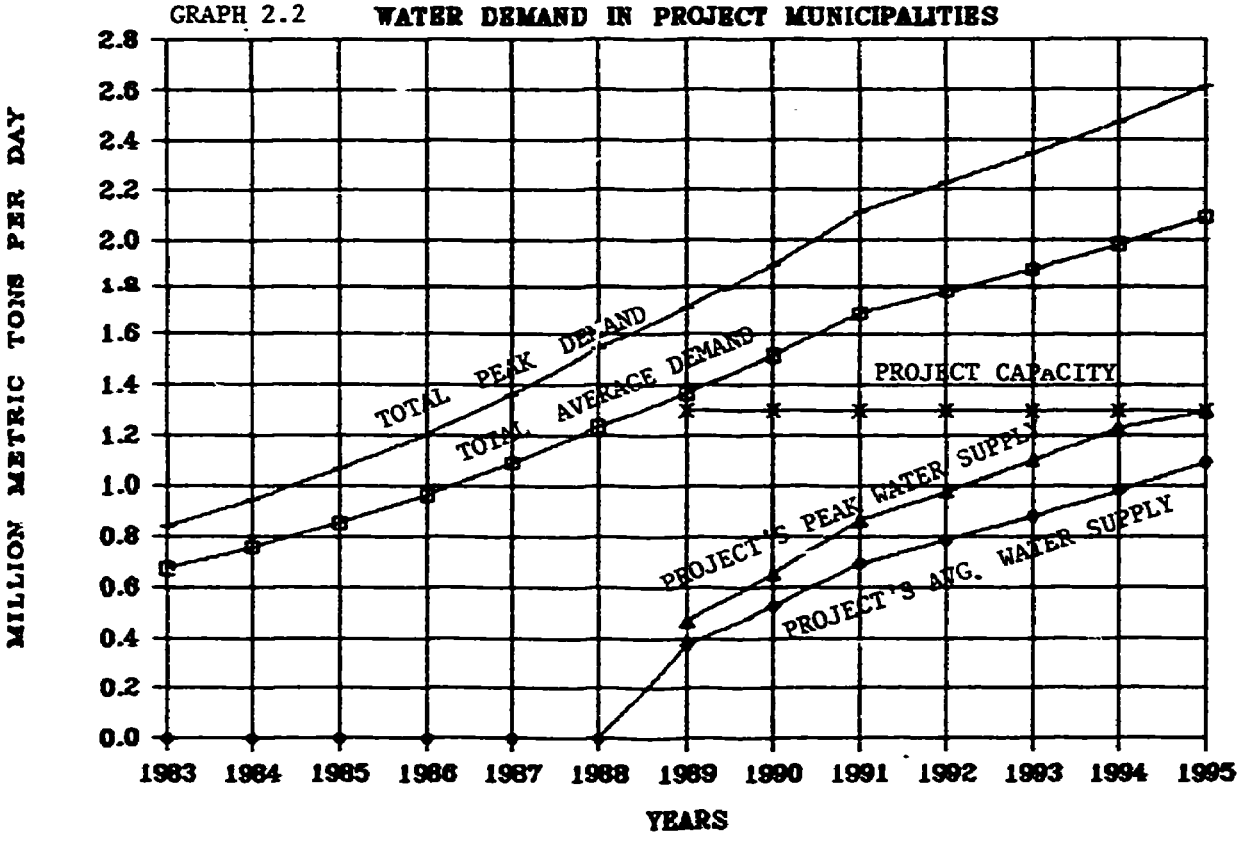
2.04 Water production in the Metropolitan Region in 1983 reached 1,361 million metric tons (mt). The population served was 12 million persons (89%). MOC and MOHA plan to increase the population served in the 25 project municipalities from 77% in 1983 to 92% by 1991 (Annex 3, Table 2). During the

1/ Seoul can extract additional water directly from the Han River upstream of the city. Seoul is building additional intake and treatment facilities for 1.3 million mtpd, to cover, from this source, its water demand until the mid-1990s.

GRAPH 2.1



GRAPH 2.2



last few years, demand exceeded the water production capacity, resulting in water rationing and low pressures. This has been a cause of serious conflict among the various cities served by the two existing regional systems. Given the rapid population and industrial growth of the region, these water shortages would continue to increase until the proposed Project is completed. This explains the priority given to the Project by Government, and the efforts to have the proposed Project completed before end-1988.

Regional Water Supply Systems

2.05 The Han river provides 98% of the water used in the Metropolitan Region. Most of this water (60% or 2.6 million mtpd) is provided by the two regional water supply systems constructed by MOC between 1978 and 1981. The first system was financed by ADB and the second by the Government. These regional systems, which basically consist of transmission pipelines (Map IBRD 18420), extract good quality water at Paldang Dam, upstream of Seoul on the Han River, and distributes it in bulk to the municipalities. This water is needed, even by municipalities near the Han River, because of the poor river water quality downstream of Seoul (Annex 2, Table 1). These two systems are operated by ISWACO and provide bulk raw water to Seoul, Incheon and another six municipalities, and treated water to the industrial city of Banweol. The proposed project is the third of these regional systems and would provide bulk water to 25 municipalities which lack other satisfactory water sources.

Sanitation Services

2.06 The Metropolitan Region is satisfactorily served by nightsoil collection services and treatment plants, septic tanks and individual sewage treatment facilities for newer development areas, and combined storm and waste water drains (Annex 2, Table 2 shows details of existing facilities). Sanitary sewers and sewage treatment facilities serve only about 20% of the population of Seoul City. Garbage collection and disposal facilities operated by the municipalities are also satisfactory. The project municipalities maintain a high standard of public sanitation in their areas.

Water Consumption

2.07 The total water consumption in 1982 was 752 million mt or about 47 cu m per month per connection. The main demand is domestic (55%), followed by commercial and industrial (35%) and public and others (10%). The total per capita water consumption for the Metropolitan Region has doubled in the last 13 years and averages 173 lpcd, but the domestic consumption (100 lpcd) is low compared with cities of similar size or income. The feasibility study for the Project assumes that per capita water consumption would go up to 280 lpcd by 1996 to meet: (a) present unsatisfied demand due to rationing; (b) increases in demand due to rising standards of living, e.g. more extensive use of flush toilets (presently used by only 42% of the population), private baths (public baths are presently used by 70% of the population), and water consuming appliances like dish and clothes washing machines; and (c) increasing industrial and commercial demand. The appraisal demand projections are more conservative (Annex 3, Tables 1 to 6) and assume a gradual increase in water

demand, with a maximum of 230 lpcd in the larger cities and 180 lpcd in the other municipalities by 1996. A fourth regional system (with a capacity similar to the proposed project) would, under these projections, be needed by 1994 (rather that by 1992, as projected in the feasibility report).

2.08 Unaccounted-for water at 48% is a major problem for Seoul City, which has many old pipelines, some dating from 1908. Seoul is now starting to implement leak detection and rehabilitation programs. Bucheon and Incheon, (financed by the Second Water Supply Project, Loan 2350-KO), are in the process of selecting consultants to correct this problem; they have targeted reduction of unaccounted-for water from about 35% to less than 30% by 1987. The unaccounted-for water for the 25 municipalities included in the proposed Project is reported at 31%, but production metering is not reliable, and the unaccounted-for water may be higher. Bank experience shows that the reduction in unaccounted-for water is a slow and difficult process. Under the appraisal projections, the unaccounted-for water for the municipalities included in the project would average 30% by 1988, and would stabilize at about 27% thereafter.

Production Capacity

2.09 Under the appraisal projections, the total water needed by the Project's municipalities would go from 674,000 mtpd in 1983 to 1.235 million mtpd by 1988 and 1.687 million mtpd by 1991 (Annex 3, Table 3). These projections include the water demand of three special industrial development zones (Incheon, Banweol and Pyeongtaek) which have a high priority in Government development plans. About 20% of the project capacity would be needed in these areas by 1996. These areas are being promoted under the Basic Development Plan for the Metropolitan Region (available in the project file), approved by the Cabinet on June 23, 1984. The development of water supply, as provided by the Project, is essential to the success of the Government's plans, which seek to channel the Region's growth to designated areas in the Metropolitan Region. These areas, in addition to the three industrial zones, include the cities of Songtan and Banweol (served by the Project) and three districts, (Pyeongtaek, Hwasung and Anseong).

2.10 Some of the project municipalities are developing additional production facilities for about 230,000 mtpd which would avoid major water shortages until the the Project enters into operation by end-1988. The project capacity of 1.3 mtpd is based on peak water demand in 1994, excluding existing or planned water production capacity at that time. The water allocated to each municipality, based on these projections, would be contracted with ISWACO. Since 84% of the water supplied by the Project would be treated, the system would be able to accommodate variations in the demand between municipalities by diverting supplies where needed, without unused treatment capacity in individual plants. Pumping capacity would be staged and additional units would be added when needed. The population, water demand and capacity provided by the project are shown in Annex 3, Table 4 to 6, and in Graphs 2.1 and 2.2, and are summarized in Table 2.2 for the year 1991:

Table 2.2: PROJECT DEMAND SUMMARY (1991)

System name	No. of municipalities	Total Population (1000)	Average Demand (1000 mtpd)	Supplied by project (1000 mtpd)	Project capacity (1000 mtpd)	Incremental Population served (1000)
Incheon	5	2,764	788	273	560	501
Seongnam	10	1,540	453	244	425	330
Euijeongbu	6	414	93	54	100	75
Independent raw water systems	4	912	353	121	215	223
Total	25	5,630	1,687	692	1,300	1,129

III. THE PROJECT

Project Origin and Formulation

3.01 The proposed project is an important part of Government plans to upgrade and expand water services. The project was first identified in 1981 during the preparation of the First Water Supply Project (Ln. 2072-KO). The feasibility study was financed by this loan, and carried out by a consultant joint venture between Nihon Suido (Japan) and Korea Engineering Consultants Corporation (KECC). The study, completed in 1983, recommended the construction of a raw water transmission system with individual municipalities constructing and operating their own treatment facilities. This followed traditional practices adopted for the two previous bulk water systems in the Region. The Bank, however, recommended the construction of a mainly treated water system, with only three jointly operated treatment plants, providing water to groups of municipalities because such a system would be more economical to build and operate, and would lay the foundation for development of an integrated regional water system. After extensive discussions, the Government accepted the Bank's recommendations, which now form the basis for the proposed project. The initial feasibility report included 0.5 million mtpd for Seoul City. However, the Han River Development Project and recent improvements in river water quality (Annex 2) now provide a more economic source and routing for Seoul's water needs. Therefore, the project excludes Seoul City, which is constructing additional water systems for 1.3 million mtpd, which would satisfy economically its water demand until the mid-1990s. The Project was appraised in June-July 1984.

Project Objectives

3.02 The project is an integrated solution for the water needs of municipalities within the Region which do not have other water sources. The objectives of the project are to:

(a) relieve water shortages and expand the water supply to satisfy the residential and industrial needs of 25 municipalities in the Metropolitan Region, thus improving services to 5 million persons and providing bulk water for 1.1 million additional persons by 1991;

(b) establish the basis for an integrated treated water system;

(c) improve the efficiency of water services in the Metropolitan Region; and

(d) strengthen the organization of ISWACO, and provide a more rational policy and criteria for nationwide tariffs for raw and treated bulk water supply.

Bank involvement in this project has already resulted in the adoption of a more economic and better technical alternative for a major capital investment. The project would lay the physical and institutional basis for developing an integrated metropolitan system. It would also provide a vehicle for continued dialogue with key Ministries (paras. 1.08-1.10) to improve sector coordination and efficiency.

Project Description

3.03 The proposed project, the third bulk water supply system in the Metropolitan Region, would extract water from the Han River, which would, upon completion in 1985 of the Chungju Dam, have sufficient water to satisfy demand at least up to the year 2000. The proposed project would provide 1.3 million mtpd of water to 25 municipalities around Seoul City and within the Metropolitan Region (Map IBRD 18420). The Project (see details in Annex 4) includes the constructing and equipping of:

(a) a main water intake and booster pumping station for 1,200,000 mtpd at Paldang, water transmission pipelines about 11 km long and 2,200 mm in diameter and three tunnels 6.5 km long and 3,800 mm in diameter, delivering water to three water systems described in (b), (c) and (d) below;

(b) the Incheon water system serving five municipalities to the west and including a booster pumping station 560,000 mtpd capacity and water transmission pipelines 29 km long and 2,400 mm to 1,650 mm in diameter, and three tunnels 6.5 km long and 3,000 mm in diameter (the treatment plant for this system would be built, owned and operated by these municipalities);

(c) the Seongnam treated water system serving ten municipalities to the south and including a water treatment plant of 425,000 mtpd capacity, a booster pump station, and a treated water transmission pipeline about 48 km long and 1,800 mm to 1,350 mm in diameter;

(d) about 215,000 mtpd raw water supply to three municipalities and the new Banweol development area;

(e) the Euijeongbu treated water system serving six municipalities to the north and including an independent water intake from the Han River, a water treatment plant of 100,000 mtpd capacity, a booster pumping station; a treated water transmission pipeline about 24 km long and 1,100 mm to 900 mm in diameter and a tunnel 1.0 km long and 2,200 mm in diameter; and

(f) technical assistance for Project construction, design, supervision and management.

3.04 During project execution, studies would be carried out to: (a) improve the organization of water and sewerage services in the Metropolitan Region; (b) establish corporate planning within ISWACO; and (c) set policies for bulk water tariffs at a national level (see Annex 13).

Complementary Works

3.05 Six large project cities, (Incheon, Seongnam, Suweon, Banweol, Bucheon and Gwangmyeong), and the Pyeongtaek development area would use about 80% of the water supplied by the Project. These cities, with consultant support, are preparing Master Plans and staged programs for improvements and expansions of existing distribution systems. Incheon, Bucheon and Gwangmyeong would construct a jointly owned treatment plant with ADB financing. Other beneficiary municipalities in the Region have also prepared feasibility studies to utilize the water supplied by the project. These expansion programs, which are part of each municipality's own development plan are adequate, are being coordinated by MOHA and are planned for implementation between 1985 and 1988 (Annex 7). Implementation would cost about W95 billion and would be financed from internal revenues, bonds and loans. The project municipalities would increase their coverage from 77% in 1983 to about 92% by 1991 with the population connected rising from 2.8 million to 5.2 million persons in the same period. Distribution expansions and treatment plants have been implemented satisfactorily in the previous two bulk water supply systems, with the water capacity provided being fully utilized in less than four years. Assurances were obtained from the Government during loan negotiations that not later than December 31, 1988: (a) Incheon, Bucheon and Gwangmyeong would complete the construction of a jointly owned treatment plant; and (b) all project municipalities, coordinated by MOHA, would expand their distribution systems, to use the water supplied by the project.

Project Cost

3.06 The cost of the project, including physical and price contingencies, is estimated at W 191.2 billion ($252.1 million) of which W 78.0 billion ($103.2 million) or about 41% is the foreign exchange component. Taxes and duties are estimated at about $11.5 million equivalent. The base cost is expressed in January 1985 prices. The Project is in an advanced stage of detailed engineering and cost estimates are based on detailed designs, MOC's annually updated rates and prices for estimating similar works and the award for the first civil works contract. Physical contingencies have been estimated at 10% of total base cost. The studies on Bulk Water Tariffs and the organization of the Metropolitan water supply systems are being financed locally. Expected price increases over the project period amount to about 17% of total base costs plus physical contingencies. Price increases for foreign costs were estimated at 8% for 1985 and 9% for 1986-88. Government efforts to curtail inflation are likely to hold local inflation somehow below these levels, and price increases for local costs were estimated at 2.5% for 1985 and 5.5% for 1986-88. For the calculation of price contingencies, it is assumed that exhange rate adjustments will, on the average, be made to maintain "purchasing power parity" during the project implementation period. The Project Cost Summary is shown in Table 3.1 and detailed project cost estimates in Annex 5.

Financing Plan

3.07 The proposed Bank loan of $95.0 million, including the capitalized front-end fee of $0.2 million, would finance 39.5% of total project costs excluding taxes, or about 35.7% of the gross costs of $266.3 million, including interest during construction ($14.2 million). Government equity would finance $171.3 million (64.3%). The financing plan was reviewed during loan negotiations and Government contributions were confirmed, including W 20 billion for 1985. On project completion, assets and debt service liabilities would be transferred to ISWACO.

Procurement and Disbursement

3.08 Procurement arrangements for the project are summarized in Table 3.2. All civil works are grouped in four contract packages (ranging from $13 million to $50 million) to be procured through international competitive bidding (ICB) after prequalification. Due to the highly competitive construction industry in Korea, local contractors are expected to win most of the civil works contracts. All equipment and materials procurements (pipes and fittings, pumps and motors, and treatment plant, electrical, control and ancillary equipment) would be packaged into about seven contracts (ranging from $2 million to $30 million) to be awarded through ICB in accordance with Bank guidelines. However, a provision has been made that urgently needed goods, as agreed with the Bank, estimated to cost the equivalent of $0.25 million per contract, and aggregating not more than the equivalent of $5 million, may be procured by local competitive bidding, in accordance with procedures satisfactory to the Bank. A preference margin of the lowest of import taxes or 15% of the c.i.f. value, in accordance with Bank guidelines, would be granted to domestic manufacturers in bid evaluation.

TABLE 3.1 - PROJECT COST SUMMARY

WORKS	MILLION WON			% OF BASE	MILLION US$			%	MILLION US$			
	Local	Foreign	Total	COST	Local	Foreign	Total	Foreign	1985	1986	1987	1988
1) RAW WATER COMPONENTS:	30327	23248	53575	34.1%	37.9	29.1	67.0	43.4%	11.7	20.6	21.9	12.7
CIVIL WORKS:	22051	9243	31294	19.9%	27.6	11.6	39.1	29.5%	9.2	13.7	11.7	4.4
EQUIPMENT AND MATERIALS	8276	14005	22281	14.2%	10.3	17.5	27.9	62.9%	2.5	6.9	10.2	8.2
2) INCHEON SYSTEM	17940	12692	30632	19.5%	22.4	15.9	38.3	41.4%	4.3	11.9	14.2	7.8
CIVIL WORKS	14341	6473	20814	13.2%	17.9	8.1	26.0	31.1%	3.4	8.0	9.2	5.5
EQUIPMENT AND MATERIALS	3599	6219	9818	6.2%	4.5	7.8	12.3	63.3%	1.0	4.0	5.0	2.3
3) SEONGTAN SYSTEM:	24883	17421	42304	26.9%	31.1	21.8	52.9	41.2%	7.6	15.9	16.7	12.6
CIVIL WORKS	18509	6036	24545	15.6%	23.1	7.5	30.7	24.6%	4.6	9.2	9.2	7.7
EQUIPMENT AND MATERIALS	6374	11385	17759	11.3%	8.0	14.2	22.2	64.1%	3.0	6.7	7.5	4.9
4) EULJEONGBU SYSTEM	10199	8091	18290	11.6%	12.7	10.1	22.9	44.2%	2.6	6.1	7.7	6.4
CIVIL WORKS	7445	2752	10197	6.5%	9.3	3.4	12.7	27.0%	1.9	3.8	3.8	3.2
EQUIPMENT AND MATERIALS	2755	5338	8093	5.1%	3.4	6.7	10.1	66.0%	0.7	2.3	3.9	3.2
5) LAND ACQUIS. & COMPENSATION.	7900	0	7900	5.0%	9.9	0.0	9.9	0.0%	4.9	4.0	1.0	0.0
6) ENGINEERING & TECH.ASSIST.	3604	976	4580	2.9%	4.5	1.2	5.7	21.3%	1.6	1.6	1.2	1.2
BASIC COST, PRICES OF 1/ 1985	94854	62427	157281	100.0%	118.6	78.0	196.6	39.7%	32.9	60.2	62.8	40.7
PHYSICAL CONTINGENCIES 1]	9485	6243	15728	10.0%	11.9	7.8	19.7	39.7%	3.3	6.0	6.3	4.1
TOTAL CONSTANT PRICES 1]	104339	68670	173009	110.0%	130.4	85.8	216.3	39.7%	36.2	66.3	69.0	44.8
PRICE CONTINGENCIES 1]	8887	9308	18196	11.6%	18.5	17.4	35.8	51.2%	0.8	6.8	14.2	14.1
TOTAL PROJECT COST 1]	113227	77978	191205	121.6%	148.9	103.2	252.1	40.8%	36.9	73.1	83.2	58.9
FRONT-END FEE ON BANK LOAN	0	190	190	0.1%	0.0	0.2	0.2	100.0%	0.2	0.0	0.0	0.0
TOTAL FINANCING REQUIRED 1]	113227	78168	191394	121.7%	148.9	103.5	252.3	40.8%	37.2	73.1	83.2	58.9

1] Due to rounding the last digit in totals may appear different than the sum of digits.
2] Taxes and duties are estimated at $ 11.5 million equivalent.

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100% of value of civil works and over 93% of value of materials and equipment contracts will be subject to prior Bank review. Advance contracting would be allowed because of the need to start construction of the water intake during the 1984 dry season to avoid delay in project completion. The Bank has made it clear that advance contracting would be undertaken at Government's risk and Bank financing would be contingent on the Board's approval of the project. Consultants for project supervision have been selected in accordance with Bank guidelines.

Table 3.2: PROCUREMENT OVERVIEW - COSTS AND BANK FINANCING a/
($ million)

Project Item	ICB	LCB	Other	Total cost
Civil works	137.3	-	-	137.3
	(31.0)	-	-	(31.0)
Materials and equipment	91.0	5.0	-	96.0
	(56.8)	(5.0)	-	(61.8)
Land	-		11.6	11.6
Engineering and TA			7.2	7.2
			(2.0)	(2.0)
Total	228.3	5.0	18.8	252.1
	(87.8)	(5.0)	(2.0)	(94.8)

/a Figures in parentheses are respective amounts financed by Bank loan.

3.09 The proceeds of the Bank loan would be disbursed against (a) 40% of civil works contracts; (b) 100% of ex-factory local expenditures and 100% of foreign expenditures for materials and equipment; and (c) 55% of cost of consulting services. Disbursements under contracts for equipment and materials costing $100,000 equivalent or less each will be made on the basis of statements of expenditure. Documentation will be retained by the Project Unit and reviewed by Bank supervision missions. All other disbursements will be fully documented. A Special Account of $1.5 million will be established to facilitate loan disbursements against eligible expenditures incurred. Given the advanced stage of project preparation and scheduling of civil works contracts, including advance contracting, and Government priority to complete the project before end-1988, disbursements of the proposed loan are expected to take four and a half years, somewhat faster than the average time indicated by the country disbursement profile, but in line with the experience of the First Water Supply Project. The estimated disbursement profile is shown in Annex 6. The closing date for the loan would be December 31, 1989.

Project Implementation

3.10 The project would be implemented by a Project Unit designated for this purpose under MOC's Seoul Regional Construction and Management Agency (RCMA). The Project Unit in Seoul would be managed by a Director and two Assistant Directors. The Project Unit has already been designated and the Director and key staff are in place (para. 4.04). The project would be coordinated by MOC's Director-General Water Resources, who would also provide close liaison with the Bank (Chart 1). Consultants would assist the Project Unit in construction supervision. MOC has considerable experience in implementing large foreign assisted projects (para. 4.03).

3.11 The project is in an advanced stage of preparation, final design for two of the four civil works contracts have been completed and the remainder would be completed before June 1985. The project would be implemented between August 1984 and December 1988 (Chart 3). The first contract, for which bidding documents were reviewed by the Bank, was awarded in November 1984, following ICB procedures. The project cost was revised in accordance with the results of this bid. Land acquisition and compensation for the project, involving acquisition of some 90 ha of right-of-way, is proceeding satisfactorily. The responsibility for land acquisition, engineering, bid evaluation, and construction supervision would rest with the Project Unit and the consultants. Bidding and contract award would be the responsibility of the Office of Supply (OSROK), the main Government procurement agency which has wide experience in both LCB and ICB procurement. The bulk water tariff study and ISWACO's financial management study would be financed and implemented by ISWACO through local consultants. The study of the organization of water and sewerage services in the Metropolitan Region is being financed and implemented by MOHA with the assistance of the Korea Public Administration Research Institute. The municipalities would implement the complementary works (Annex 7) with the assistance of local consultants. MOHA's Local Finance Division would coordinate, arrange financing and provide support for these municipal programs (para. 3.05).

Consulting Services

3.12 Consulting services for feasibility studies and final design were financed from Loan 2072-KO (First Water Supply Project). KECC, with support from Nihon Suido (Japan), was selected in accordance with Bank procedures. They have extensive domestic and international experience in water supply works. KECC would provide about 30 man-months of foreign consultants, and about 520 man-months of local consultants which would be needed for the construction supervision. MOC appointed an expert Design Review Panel (DRP), consisting of two water supply specialists, to advise on technical problems encountered in the project. The DRP has reviewed the feasibility studies and preliminary designs. Their recommendations have been incorporated in the final designs. ISWACO will participate in the review of the final design and operation arrangements.

Operation and Maintenance

3.13 The Project facilities, other than the treatment plants which may be operated by the municipalities, would be operated and maintained by ISWACO. ISWACO has considerable experience in the operation and maintenance of bulk water supply systems. Besides the two existing bulk water systems in the Metropolitan Region, ISWACO also operates and maintains seven other regional systems in the country (para. 4.05).

Environmental Aspects

3.14 The Project serves the main conurbation in Korea and would improve the environment and living conditions of the population. About 92% of the population is served satisfactorily by septic tanks and nightsoil disposal systems and combined waste and storm water drains. Annex 2, Table 2, gives details of sanitation facilities in the Metropolitan Region. Presently the project municipalities have a higher level of sanitation than those of comparable size in other developing countries. The Government has also started implementing programs to deal with sewerage, sewage and nightsoil treatment and pollution control based on the Environmental Master Plan Study of the Han River Basin, completed by consultants in 1984. MOHA has prepared a master investment plan for providing interceptor sewers and treatment facilities in all 49 cities (except Seoul) and 187 towns in the country, to be implemented between 1984-91. This plan, costed at W 243 billion, will be financed out of sewerage tariffs (to be levied in these municipalities starting in 1985) and government and foreign loans. Nineteen of the project municipalities would be included in and benefit from this program. Four of the largest cities, Incheon, Bucheon, Anyang and Gwangmyeong, bordering Seoul City, would also benefit from the large scale improvement works under the comprehensive Han River Development Project being implemented by Seoul City. These include the training and deepening of the main river (which will have an additional dry weather flow of about 100 cu m per sec after completion of the Chungju Dam in 1985) and construction of about 200 km of interceptor sewers along both banks of the Han River and its main tributaries. This project, estimated to cost over $600 million, would be completed by 1986. Four sewage treatment plants are also planned (two are under construction) for completion in stages by 1996, to provide adequate treatment for dry weather flows from these interceptors before discharge into the Han River. When completed in 1986, the sewer interceptors will contribute to reducing the pollution of the main water courses draining the densely populated project areas to the south of the Han River. Garbage collection and disposal services are satisfactory. OOE has also started programs to control industrial waste pollution of the waterways and atmosphere by establishment of effluent and emission standards and monitoring systems and an Environmental Fund (Annex 2). All these measures would result in a gradual improvement of the environmental conditions in the project area.

IV. THE BORROWER AND EXECUTING AGENCIES

The Borrower

4.01 The Project would be implemented by MOC. After completion, project assets and liabilities would be transferred to ISWACO. However, during project construction, the Government would analyze the benefits of transferring the operation, together with the assets and liabilities, of the two treatment plants to be built under the Project, to a joint organization of the beneficiary municipalities. Organization arrangements for joint ownership and operation under the municipalities could be the same as for the treatment plant serving Incheon, Bucheon and Gwangmyeong. Organization for the latter has been studied by consultants under a technical assistance grant from ADB. In any case however, ISWACO would own and operate the main bulk water system and transmission pipelines, which represents 93% of the project cost.

4.02 The borrower would be the Government which would relend the Bank loan to ISWACO. Assurances were obtained that a Transfer and Operations Agreement, a draft of which will be presented to the Bank for comments by December 31, 1987, would be signed with ISWACO prior to completion of project.[2/] Relending terms and conditions would be the same as for the Bank loan plus a 0.05% p.a. handling charge. The foreign exchange risk would be borne by ISWACO. A Project Agreement for the operation, maintenance and financial covenants would be executed with ISWACO.

Implementing Agency: Ministry of Construction

4.03 The Regional Construction and Management Agencies (RCMA) under MOC are responsible for the implementation of MOC's projects. There are five RCMAs in Korea - Seoul, Weonju, Daejeon, Iri and Busan. Seoul is the largest RCMA, and is implementing 30 projects, including four road subprojects financed by the Bank and the sewage treatment plant for Banweol being financed by ADB. The previous two regional systems were also implemented by Seoul RCMA. MOC has implemented satisfactorily several projects financed by the Bank and other international agencies.

4.04 The RCMAs are managed by a Director General, and have the following divisions: General Services, Roads, Rivers' Improvement, Laboratory, and special construction offices. A Project Unit has been established for the project, under Seoul's RCMA Director General, in coordination with the Director General of the Water Resources Bureau (Chart 1). The Project Unit is responsible for supervision under the Director, Rivers Improvement Division, with two Assistant Directors (planning and construction), and 13 engineers.

2/ If the beneficiary municipalities would own the two treatment plants (estimated to have loan-financing of about $5 million) another Transfer and Operations Agreement for this purpose would be signed with MOHA, representing the municipalities.

The consultants preparing the final design have been instructed to assist in the project supervision. Before their present contract ends by April 30, 1985 an additional contract for the supervision of the project would be signed. The draft terms and conditions of this contract have been reviewed by the Bank and are satisfactory. These project supervision arrangements are satisfactory. MOC's accounting department would be responsible for project cost accounting. MOC's accounts are audited internally by the Inspector-General's Office of MOC and are also independently audited by the Board of Audit. Assurances were also obtained that within six months of the end of each fiscal year MOC would send to the Bank a summary of the project cost accounts, as audited by independent auditors acceptable to the Bank.

The Operating Agency: ISWACO

4.05 ISWACO would be responsible for the operation, maintenance and debt service of the project. ISWACO is operating satisfactorily the two existing metropolitan systems, which provide bulk raw water to Seoul City and seven other municipalities in the Metropolitan Region and treated water to the city of Banweol. In addition to these two metropolitan systems, ISWACO also operates seven other regional systems (Ulsan, Pohang, Majin, Yeocheon, Daedug, Geoje and Gumi). ISWACO is also the borrower for two previous Bank loans: The Chungju Multipurpose Dam Project (Loan 1666-KO), scheduled for completion by mid-1985, and the Second Water Supply Project (Nagdong Barrage, Loan 2350-KO), effective in January 1984, both of which are being executed satisfactorily.

4.06 ISWACO was established in 1974, for the purpose of promoting industrial sites and water resources development, and: (a) undertakes the development of industrial sites and special areas; (b) constructs, operates and maintains multipurpose dams for water supply, irrigation, flood control and power generation; and (c) operates regional water supply systems which provide raw or treated bulk water for municipal and industrial use. ISWACO has planned and constructed nine industrial estates and new cities, five multi-purpose dams, and operates nine regional water supply systems. ISWACO's investments in new projects are considerable, and about $360 million would be invested this year by its Dams Division alone. The largest dams under construction are Chungju (financed by Loan 1666-KO), Hapcheon (financed by OECF), the Nagdong Barrage (financed by Loan 2350-KO), the Juam Dam (also financed by OECF) and the Imha Dam scheduled to start construction in 1985. Feasibility studies are being prepared by consultants for another five multipurpose dams which are expected to be built within the next ten years.

4.07 ISWACO is managed by a Board of Directors consisting of a Chairman, the President of ISWACO, MOC's Director General of Water Resources, the Manager for Government Invested Corporations, and two other persons appointed by MOC. ISWACO's President is appointed by the President of Korea. ISWACO also has a Vice President and four Directors (Administration, Industrial Sites, Water Resources and Public Utilities), and an Auditor (Chart 2). The Auditor is appointed by MOC for a period of two years. The Vice President and Directors are appointed by MOC for a period of three years. ISWACO has developed into a large and competent organization with 15 departments, 18 local offices and 1,278 employees, 42% of whom are in Daejeon at head-

quarters and the others in local offices or construction sites. Many of ISWACO's 500 engineers have been trained abroad and, working together with foreign consultants, have acquired considerable experience in the design, construction, operation and maintenance of many large projects. Any loans applied for by ISWACO have to be approved by MOC. ISWACO has insurance against fire, as well as for vehicles, and is self-insured against other risks. ISWACO's financial statements are being satisfactorily audited by independent private auditors. Assurances were obtained during negotiations that ISWACO's financial statements would continue to be independently audited, and that a copy of the auditor's report would be sent to the Bank by July 1, six months after the end of each fiscal year.

ISWACO's Operations

4.08 ISWACO's operation is efficient, with administrative expenses representing less than 5% of the operational expenses. Public enterprises are often affected by low efficiency, deficient budgetary controls, excessive staff, limited collection of revenues, etc. In May 1984, the Government, as part of its Structural Adjustment policy, enacted the Public Enterprise Reform law which provides more autonomy to public enterprises, but also creates mechanisms to improve their efficiency. Under this law, Boards of Directors are established to approve the budget, set policies and medium- and long-term objectives. Each of the 25 public enterprises are evaluated annually following clear guidelines (available in Project File). The criteria used include quantifiable results (profits, net sales, percentage of management expenses, etc.), and nonquantifiable variables (long-term planning, research, promotion of advanced technology, etc.). Enterprises are ranked, and the normal end of year bonus for all employees is then awarded based on such rankings. Employees in enterprises ranked "A" receive up to six months salaries as an annual bonus, and those in the lowest rank "D" receive three months salary bonus. This system is creating changes in management attitudes (for example ISWACO now refuses to undertake unprofitable projects) and in the motivation of managers and employees. ISWACO's management is consequently very receptive to new ideas to improve itself. While ISWACO has shown continuing improvements in its financial performance, it still does not have adequate long-term corporate financial planning in its organization. Strengthening in this area is needed, to consolidate its financial sections now dispersed in several divisions, to prepare long-term financial projections and introduce an improved management information system. Assurances were obtained during negotiations that ISWACO would carry out and send to the Bank for comments not later than December 31, 1986, a study to make recommendations to strengthen its financial management and corporate planning.

4.09 ISWACO's water operations are well run, telemetering is used to control and measure the water being provided to each city, bulk water is measured at pumping stations and at users' intakes, statistical information is adequate, water services are reliable, reported unaccounted-for water is less than 5%, and accounts receivable are less than 30 days. Meters are calibrated regularly and there are meter shops at different locations. However, the long-term planning for maintenance of the water pipelines, their corrosion protection and monitoring, the optimization of the efficiency of pumping to adjust for daily variations of water demand require improvements. Assurances

were obtained during negotiations that a suitable maintenance and inspection program for the Metropolitan systems including corrosion protection and monitoring, would be sent by ISWACO to the Bank for review and comments not later than December 31, 1986.

V. FINANCIAL ANALYSIS

ISWACO - Financial Performance

5.01 ISWACO is a corporation owned by the Government (95%) and the Korea Development Bank (5%). Its authorized capital is W 500 billion, ($625 million) of which W 280 billion was paid in as of December 31, 1982. ISWACO has been growing rapidly and its fixed assets increased 3.7 times in the last four years. ISWACO's main sources of funds have been Government equity contributions, loans from KDB and the Oil Fund,[3/] foreign loans and internal cash generation.

5.02 ISWACO's financial performance between 1978-83 has been generally satisfactory with a debt/(debt plus equity) ratio of 54% and a current ratio of 1.4. However, ISWACO's net income has only been 2% of its equity, and its operating ratio was almost 100%, primarily due to the effect of the Industrial Sites Division (para. 5.03). ISWACO's financial statements are shown in Annex 10, and a summary is presented in Table 5.1. ISWACO's corporate financial planning has been hindered by the lack of clear Government policies for its rates and tariffs. Under the Project, financial targets for the Water and Dams Divisions would be implemented (para. 5.07), and tariff studies (para. 1.07) and a study to strengthen ISWACO's financial management (para. 4.08) would be carried out.

Industrial Sites

5.03 ISWACO's main activity at its inception in 1974 was in the water sector, but during subsequent years its main activity has been the construction of industrial sites and new towns. Industrial sites and new towns are financed by Government equity contributions and long-term loans from KDB. After construction these industrial sites, together with related loan obligations, are sold at cost. With the completion of many of these projects, ISWACO's revenues and expenses from these activities have been declining. This explains the decrease of revenues from W 151 billion in 1979 to W 73 billion in 1982, with a corresponding reduction in operating expenses from W 150 to W 71 billion during this period. Therefore the net income and cash generation now depend on the other ISWACO activities, namely those of the Dams and Water Supply Divisions. The financial analysis for ISWACO is centered on these divisions.

3/ A facility established by Government in 1983 to finance energy development projects out of oil sales taxes.

Water Division

5.04 MOC finances all production and transmission systems for bulk and treated water supplies (regional systems) for groups of municipalities and industrial zones; these systems are operated by the Water Division. 92% of its revenue is from the sale of raw water, while treated water provides the remaining 8%. Presently ISWACO provides water to nine regional systems including the two existing Metropolitan regional systems (para. 4.05). MOC has prepared feasibility studies for three other regional systems, including the proposed project, to serve some 50 municipalities. Partly due to the project, ISWACO's raw water sales are expected to increase from 1,120 to 1,520 million tons per year, and its sales of treated water from 56 to 300 million tons per year, between 1984-90 (Annex 8). During the 1982 drought, ISWACO's sales of hydro-generated power were reduced from 988 to 614 GWh resulting in a deficit of W 1,662 million in the Dams Division (Table 5.2), while the Water Division increased its revenues by 60%, and had a profit of over W 7,000 million.

Table 5.1: ISWACO'S SUMMARY FINANCIAL STATEMENTS (AUDITED)
(W million)

	1978	1979	1980	1981	1982	1983
Operating Revenue	85,307	151,284	104,564	75,551	73,084	96,987
Less: Operating expenses	85,600	150,061	104,421	73,458	71,369	90,462
Operating income (loss)	(-293)	1,223	143	2,093	1,715	6,525
Nonoperating income (net)	1,431	2,047	3,485	3,736	3,129	2,794
Net income	1,138	3,270	3,628	5,829	4,844	9,319
% operating ratio	100.3	99.2	99.9	97.2	92.7	93.3
Net income as percentage of equity	1.4	2.2	2.3	2.2	1.5	1.6
Current assets	19,547	37,825	26,815	36,415	46,772	116,584
Deferred charges	9,843	6,119	16,378	17,732	19,372	12,809
Net fixed assets	177,205	288,705	357,709	609,394	659,324	922,897
Total Assets	206,595	332,649	400,902	663,541	725,468	1,052,290
Current liabilities	13,238	25,984	41,390	48,681	54,264	88,049
Long-term debt	109,779	152,999	197,849	346,078	333,855	381,533
Reserves	2,723	4,269	5,025	6,476	8,651	10,420
Equity	80,865	149,397	156,638	262,306	328,698	572,288
Total Equity and Liabilities	206,595	332,649	400,902	663,541	725,468	1,052,290
Current ratio	1.48	1.46	1.54	1.34	1.36	1.32
% Debt/(debt + equity)	58	51	56	58	50	40

Table 5.2: ISWACO'S REVENUES AND EXPENSES
(W million)

	1982			1983		
	Revenues	Expenses /a	Gross profit	Revenues	Expenses /a	Gross profit
Industrial sites,	28,823	28,823	0	41,955	41,955	0
Water supply	32,099	24,943	7,156	34,945	27,980	6,965
Dams	11,030	12,692	-1,662	18,120	15,312	2,808
Other revenues/expenses	1,132	1,264	-132	1,967	1,217	750
Total	73,084	67,722	5,362	96,987	86,464	10,523
General expenses	-	3,647	-3,647	-	3,998	(3,998)
Other income	4,875	779	3,935	4,478	23	4,455
Income taxes	-	806	-806	-	1,661	(1,661)
Net income			4,844			9,319

/a Including depreciation.

5.05 ISWACO's nationwide tariffs for raw and treated water include fixed charges for the basic contracted quantity, metered charges varying with the volume used and surcharges for volumes used in excess of the contracted supply (Table 5.3). The criteria to set these tariffs, the ratio between fixed charges (for volume contracted with each city), and metered charges for the water used and the need to have surcharges in places where water is very expensive would be studied under the project (para. 1.07, and Annex 13).

Table 5.3: ISWACO'S WATER TARIFF (June 1984)
(Won per ton)

	Fixed charges (contracted quantity)	Metered charges (usage)	Total	Surcharge for excess over contracted quantity
Raw water	17	13	30	55
Treated water	56	8	64	70

Dams Division

5.06 The Dams Division operates five dams (Andong, Soyang, Daecheong, Nam and Seonjin), and is constructing three additional dams and the Nagdong Barrage (Chart 2). Its main source of revenue is the sale of bulk power to the Korea Electric Power Company (KEPCO). These revenues represented 84% of the total in 1983 and are expected to increase to 86% by 1986 (Annex 9). ISWACO's power generation would increase 138% between 1984-86 upon completion of the Chungju Dam. The other 16% of the Division's revenues in 1983 were water rights charges levied on municipalities and industries which use water from rivers regulated by ISWACO. The volume of such water billed (including the Nagdong Barrage) would double by 1988, from 1,048 to 2,160 million tons. The cost of each dam is allocated to power, water, irrigation, land reclamation, flood control, etc., in proportion to their respective benefits or alternative costs. ISWACO's efforts to collect agricultural water charges, to recover a portion (30%) of the cost allocated to irrigation, have been strongly opposed by farmers and the Ministry of Agriculture, which wants to subsidize food production. ISWACO expects to increase the irrigated area paying charges (of around $25 per ha per year) from 190 ha in 1983 to 8,500 ha by 1988, but this would still include only a fraction of the total irrigated land served by ISWACO. ISWACO's revenues from this source would, however, increase from the present W 13 million to W 227 million by 1988. Cash operational expenses, including taxes, were 34% of the Division's revenues in 1983, and under the proposed rate of return covenant (para. 5.07) are expected to represent only 12% of the revenues by 1988, with depreciation representing 33% and the return on investment the other 55% of its revenues.

Financial Covenants

5.07 As in the Second Water Supply Project, agreement was reached during negotiations that ISWACO's minimum rates of return for its Water and Dams Divisions would be 4% in 1985 and 5% thereafter. These rates of return provide a satisfactory financial performance and are reasonable in view of: (a) for the Dams Division - the lumpiness of the dams investments, and the provision of services which are not fully recuperable from users (like water taken from the rivers for irrigation and expenses in flood control); and (b) for the Water Division - the provision of satisfactory water services to the

poorest regions at a reasonable price, promoting an equitable development of the country. These rates of return would allow ISWACO to pay its operational expenses, depreciation and debt service, and internally finance 15% of the large planned investments in dams between 1984-88 ($1,080 million), which represent 3.2 times its net fixed assets in 1983 (Annex 9). Compliance with this covenant would produce a satisfactory cash balance, but requires considerable efforts. In the Dams Division power charges would need to be increased 115% (38% between 1984-88) and the charges for water rights increased by 180% in real terms between 1982-88 (26% between 1985-88). Ir the Water Division, tariffs would have to be adjusted about 15% in real terms between 1984-88. ISWACO's power tariffs are negotiated with KEPCO in consultation with EPB and the Ministry of Energy. ISWACO's water charges are approved by MOC in consultation with EPB.

5.08 These rates of return would be based on fully revalued assets. Fixed assets were revalued in 1983 for the Dams Division, and are being revalued for the Water Division. Korea's Assets Revaluation Law allows the revaluation of fixed assets when their estimated value exceeds 25% of the book value. Assets revaluation is detailed, complicated and requires the approval of Government's Board of Audit and Inspection. Agreement was also reached that for rate analysis, the value of these fixed assets would be adjusted periodically until the next formal revaluation, using 85% of the annual increase of the wholesale price index as a conservative proxy for the increase in value of these assets. This system is used in the financial projections.

5.09 ISWACO's rates of return in 1984 are projected to be about 2.7%, which is short of the covenanted 4%. This lower than expected performance is mainly the result of: (a) for the Dams Division - the assets revaluation which doubled value of fixed assets at end of 1983, and (b) for the Water Division - price increases which doubled the charges for the water used from rivers, and increases of 9% in power costs (which represent half of its expenses). ISWACO has made a considerable effort to comply with the covenant under Loan 2350-KO. Between 1982 and 1984 its power rates were increased from W 13.8/Kwh to W 23.7/Kwh (58% in real terms), and water rights charges were increased from W 1.9 per ton to W 3.7 per ton (78% in real terms). Although Government has a major policy effort to stabilize prices and control inflation, ISWACO's water rates were increased by 10% before Board presentation. This would ensure compliance in 1985 with the rate covenant of the Water Division. Since the power generated and sold to KEPCO by ISWACO would increase by 71% in 1985, and 138% in 1986 (upon completion of Chungju Dam), the financial performance of the Dams Division would depend mainly on the power tariffs set for Chungju. The tariff study prepared by ISWACO's consultants recommends a power rate for Chungju Dam of W33.6 per Kwh. This study uses standard methods followed in Korea for ISWACO's rates. Chungju power rates would be implemented before this dam enters into operation by mid-1985, allowing compliance with the covenanted rate of return for the Dams Division in 1985 and 1986.

Future Financial Performance

5.10 Under the proposed covenant (para. 5.07), the financial position of the Dams Division would be satisfactory (Annex 9): its working ratio would average 13%, its debt service ratio would average 1.5, and its debt/debt plus equity would be below 39%. After 1988, annual investments of about $60 million would be internally financed, and additional cash would be available to contribute to the construction of the other dams being planned by MOC. The Water Division would also have a satisfactory financial performance (Annex 8), with its working ratio averaging 67%, its debt service ratio 4.5, and its debt/debt plus equity would be lower than 15%. After completion of the proposed project, this Division would rapidly accumulate cash that would allow ISWACO to make internal contributions to the construction of other regional projects being planned, and to the next stage for the Metropolitan Region water system. Additional investments and their financing could affect ISWACO's financial position. Assurances were obtained during loan negotiations that ISWACO would not incur any additional long-term debt without prior Bank concurrence, unless its debt service coverage exceeds 1.3 in any calendar year. Financial highlights of the Water and Dams Divisions are presented in Tables 5.4 and 5.5 respectively. Consolidated financial statements for ISWACO are shown in Annex 10.

5.11 Under the new Public Enterprise Law (para. 4.08) ISWACO is making a serious effort to increase its management efficiency and profitability. Because of the above concerns ISWACO has reservations about undertaking the operation of the Geum Gang regional system, expected to be completed by the beginning of 1985, since projected initial revenues may not cover even power charges (partly because of over-design). ISWACO has also had to take responsibility for operating at least one other bulk water supply system in the past which was not financially viable due to overdesign. ISWACO has hired the Korean Industrial Development Institute to study this problem and recommend conditions, tariffs and/or subsidies under which the Geum Gang system could be administered by the beneficiary cities or by ISWACO. If ISWACO takes over the operation of this system, the Bank would consider how the assets and liabilities of this particular system (for which present projections are only rough estimates) would be taken into consideration in the rate of return calculation (Annex 12).

Table 5.4: FINANCIAL HIGHLIGHTS - WATER DIVISION (Annex 8)

	1982	1984	1986	1988
Raw water tariff - w/mt	32.7	32.0	37.3	44.1
Treated water tariff	74.5	74.4	86.7	102.5
Total revenues (million W)	32,100	40,000	49,600	60,000
Operational expenses (million W)	20,950	28,950	34,300	39,600
Depreciation (million W)	4,270	5,550	5,980	8,100
Net income (million W)	6,420	5,290	8,770	11,560
% working ratio	65	72	69	66
% rate of return (on revalued assets)	4.3	3.0	5.0	5.0
Capital expenditures (million W)	240	1,860	58,542	57,300
Debt service coverage (times)	5.5	4.8	6.3	5.8
% debt/(debt + equity)	9	9	11	18

Table 5.5: FINANCIAL HIGHLIGHTS - DAMS DIVISIONS (Annex 9)

	1982	1984	1986	1988
Power rate W/kWh	13.8	23.7	31.6	38.9
Water rights rate W/mt	1.9	3.7	5.4	6.9
Total revenues (million W)	10,400	19,850	55,750	83,100
Operational expenses (million W)	5,000	5,330	7,760	9,960
Depreciation (million W)	5,560	8,030	17,890	27,570
Net income (million W)	-2,670	4,680	18,530	21,580
% working ratio	48	27	14	12
% rate of return (revalued assets)	-0.1	2.4	5	5
Capital expenditures (million W)	91,900	285,800	171,500	46,600
% capital expenditures to net fixed assets	55	109	26	5
Debt service ratio	0.8	1.2	1.8	1.5
% (Debt/debt + equity)	39	36	38	31

Reporting Requirements - Monitoring Indicators

5.12 In order to permit the satisfactory monitoring of the investment program and financing plans, assurances were obtained during negotiations that:

(a) ISWACO would send to the Bank five-year financial projections for the Water and Dams Divisions before August 31 of each year. The projections would include an income statement, statement of cash flow, balance sheet with details of water and power demand, programmed investments and financing resources;

(b) ISWACO would send to the Bank not later than August 31 and February 28 of each year semiannual information on monitoring indicators (Tables 5, Annexes 8 and 9) and the compliance with loan covenants; and

(c) MOC would send to the Bank semiannual reports of project execution and cost and would prepare a project completion report satisfactory to the Bank, not later than six months after the loan closing date.

VI. PROJECT JUSTIFICATION

Introduction

6.01 The proposed project meets urgent water needs for 25 municipalities in the Metropolitan Region. This Region is the administrative, political and economic center of Korea, with 37% of the population and almost half of the industrial employment and GNP. Rapid population and industrial growth has outpaced the provision of water services. The project would provide the water needed for the Region's sustained development.

Project Benefits

6.02 Upon completion of the project, 5 million persons in 25 municipalities would have an improved water supply, be free of rationing and low water pressures, and would be able to increase their usage of water for residential, commercial and industrial purposes. After completion of expansions to the distribution networks (para. 3.05), the project would make water available to 1.1 million additional persons by 1991 and 2.3 million persons by 1996. It is estimated that about 26% of the incremental population to be served with water are below the relative urban poverty threshold. This would mean that by 1991 the number of poor with house connections would more than double. Since most of the urban poor now are either unserved, or have less reliable or convenient service (standpipes, low pressure, water rationing, etc.) they would be benefitted by the expansion of water supply, the improvement of service and the increase in coverage (from 77% in 1983 to 87% by 1988 and 92% by 1991), with practically everybody being served by house connections in the main project cities (Annex 3, Table 2). Financial projections for a sample of the beneficiary municipalities, available in the Project File, show that no major tariff

increases are expected at the consumer level as a result of the project. Water charges are affordable to the whole population. This is because tariffs are progressive, with large residential consumption being charged at up to six times the minimum rate. Water charges of up to 5% of the household income are normally considered affordable. In the Metropolitan Region, water charges for a minimum consumption of 10 to 15 tons per family are about W 600 per month ($0.75). This represents less than 1% of the monthly household income of the lowest percentile (Annex 11, Graph 2).

6.03 The project would also have significant benefits through institution building and sector policy development. These include: (a) the provision of centrally treated water to all but four of the 25 municipalities included in the Project, in contrast to the two existing Metropolitan Region systems, which provide raw water, requiring each beneficiary municipality to build independent water treatment plants; (b) agreement with the Government to study: (i) the policies and tariff levels for bulk water, which would have a national impact and affect the large number of municipalities served by the nine existing regional systems operated by ISWACO and the new regional systems being built by MOC; (ii) improvement of ISWACO's financial management; and (iii) improvements to the organization of water and sewerage services in the Metropolitan Region, which are expected to result in the establishment of a Water Authority, and which would increase efficiency, reduce cost, equalize retail tariffs and eliminate unfairness in the provision of these services. The establishment of bulk treated water supply systems under this Project is an important step towards an integrated organization which may be advanced further by the joint ownership and operation of treatment plants by the municipalities.

Least-Cost Solution

6.04 The selection of the least-cost solution was a major issue during project preparation (Annex 1). The proposed treated water system selected (para. 3.01) is the least cost solution for the whole region, and is considerably less expensive and more efficient than the raw water systems built under the two existing regional projects. The route selected for the pipelines is also the least expensive, avoiding as much as possible crossing the more densely populated areas in the Region (Annex 11, para. 1).

Rate of Return

6.05 The Economic Rate of Return (ERR) for the Project, based on existing water tariffs and the total cost of providing water to the households served by the Project, is estimated at 14% (Annex 11, Table 3). Sensitivity analysis shows that a 10% increase in the investment cost, or a two year delay in completing the Project would reduce the ERR to 13%, and that the ERR would be 11% even if the investment and operational expenses were increased by 15%. The Project would, for the first time, provide water to extensive areas within the Metropolitan Region, allowing residential, industrial and commercial development. The ERR, including the project benefits expected to be reflected in real estate values, is estimated at 19%. The internal rate of return, based on ISWACO's charges for treated water to the municipalities is 10%, indicating that bulk water tariffs are somewhat lower than the marginal cost of water.

These rates of return underestimate the economic benefits of the project because: (a) they are based on the average charges for treated water, which only partially represent the consumer willingness to pay for water (as evidenced by excess consumption charges up to three times higher than the average tariff); and (b) they exclude other important benefits which are difficult to quantify, like the provision of better services to present consumers, the improvement of living standards and the health and general welfare of the population. The water provided by the project is the only water source for most municipalities and is therefore essential for the Region's development.

Marginal Cost

6.06 The marginal cost for the treated water is W 89 per ton in 1985 prices (US$0.11 per cubic meter) for a discount rate of 10%, (Annex 11, Table 2). Present bulk water tariffs for treated water are 8% lower (W 82 per ton), which is the marginal cost for a discount rate of 9%. This indicates that present rates are close to the optimal marginal cost pricing. Tariff studies under the project (para. 1.07) would further review and propose improvements on these tariffs. Retail water tariffs are affordable, representing less than 1% of the household income even for the lowest 10% percentile (para. 6.02).

Project Risks

6.07 There are no special risks in the Project. However, given MOC's large investment needs, Government's tight budget controls could reduce annual budgetary allocations and slow down project implementation. This is not likely given the priority accorded to the Project and the Government's determination to complete it before end-1988. The Government has also given assurances that it will furnish sufficient and timely counterpart funding. In addition, there are risks that the municipalities may not build the necessary distribution works in time and that project benefits would be delayed. This has not been a problem in the two existing systems in the Region, where the system capacity, normally designed for a 7 to 10 year horizon, was fully used within four years. The Government, however, provided assurances that the necessary complementary works would be completed by December 31, 1988 (para. 3.05). Sewerage and sewage treatment works, and other pollution control measures are being undertaken that would ensure that the additional wastewater resulting from the project would not result in environmental deterioration (para. 3.13 and Annex 2).

VII. AGREEMENTS REACHED AND RECOMMENDATIONS

7.01 Agreements were reached with the Government during loan negotiations that:

(a) a study for the implementation of the organization of water and sewerage services within the Metropolitan Region would be made available to the Bank not later than December 31, 1986 (para. 1.07(b));

(b) Incheon and the other project municipalities in the Metropolitan Region would implement the specified complementary works not later than December 31, 1988 (para. 3.05);

(c) Government would provide the necessary local funds (para. 3.07);

(d) A Transfer and Operations Agreement between MOC and ISWACO, a draft of which would be presented for Bank comments by December 31, 1987, would be signed before project completion (para. 4.02).

(e) MOC project accounts would be audited annually (para. 4.04);

(f) ISWACO would achieve rates of return of 4% in its Water and Dam Divisions in 1985, and 5% thereafter (para. 5.07) on revalued assets (para. 5.08); and

(g) semiannual reports and a project completion report would be sent to the Bank (para. 5.12).

7.02 Agreements were also reached during loan negotiations that:

(a) ISWACO would make studies for a raw and treated water tariffs policy which would be presented to the Bank not later than June 30, 1986 (para. 1.07 (a));

(b) ISWACO's financial statements would be audited annually (para. 4.07);

(c) ISWACO would carry out and present to the Bank not later than December 31, 1986, a study to strengthen its financial management and corporate planning (para. 4.08);

(d) a suitable maintenance and inspection program for the Metropolitan Systems would be presented to the Bank by ISWACO not later than December 31, 1986 (para. 4.09);

(e) ISWACO would not incur additional long-term debt unless debt service coverage exceeds 1.3 in any calendar year (para. 5.10); and

(f) ISWACO would present annually 5-year financial projections, and semiannually information on monitoring indicators (para. 5.12).

7.04 With the above agreements and conditions the proposed project is suitable for a Bank loan of $95 million, for a term of 15 years, including a grace period of three years at the Bank standard variable interest rate. The borrower would be the Republic of Korea.

KOREA

METROPOLITAN REGION WATER SUPPLY PROJECT

Water Supply - Existing Facilities and Proposed Improvement

Population and Demand

1. The Metropolitan Region, including Seoul City, had a population in 1981 of some 12.4 million persons in 40 municipalities (Table 1). In 1983, the population in the 25 project municipalities was 3.7 million. The average growth rate in the project municipalities has been about 7.3% (1981-83) and is expected to decline gradually to about 3.7% (1991-96). Overall, about 86% of the population in the region had access to piped water in 1981, including Seoul City. In the project municipalities, coverage varied from 92% in Incheon to 11% in Yongin. Three of the smaller municipalities had no piped water service at all in 1981, although by 1983 all but one had started piped water services from local sources. Water consumption in 1981 varied from a high of 242 liters per capita per day (lcpd) and 195 lcpd in Banweol and Incheon respectively (both cities with very high industrial demand) to 165 lcpd in Seoul City and about 100 lcpd in the average small municipality in the project area (Table 2). Unaccounted-for water was highest in Seoul City at 48% and averaged about 35% in the project municipalities, with about 20% in the smaller municipalities. These statistics are, however, not reliable for the smaller municipalities, because of the lack of adequate production metering facilities.

Water Sources

2. The municipalities involved in the project have no direct access to the Han River (except Incheon, Gwangmyeong and Bucheon downstream from Seoul City) and many are at considerable distances (30-60 km) from this only reliable source (Map 1). Local water sources, including groundwater, are no longer adequate to meet present demand. Eight of the project cities are also served by the two existing regional water supply systems, which are now operated almost at their full capacity of 2.6 mtpd.

Complementary Works

3. The five main project cities of Incheon, Bucheon, Gwangmyeong, Anyang and Suweon would use about 60% of the project's water with about abother 20% being earmarked for new development areas around Pyeongtaek and Banweol. The five cities all have Master Plans for water supply development in their areas, and the Ministry of Construction (MOC) recently published a Basic Development Plan for the Metropolitan Region, approved by the Government, which *inter alia* provides for the development of the Pyeongtaek/Banwoel areas for decentralization of industry from Seoul and other densely populated cities. The smaller municipalities are undertaking feasibility studies for planned improvements to their water supply systems to cope with increasing demand and utilize the additional water allocated to each of them from this project. Annex 7 gives details of additional treatment plants, transmission and distribution expansion, and new service reservoirs expected to be

constructed by each of the cities before the proposed project comes into operation in 1988. These plans are being coordinated by MOHA which will also assist the cities to finance these investments by approving bonds and arranging local or foreign loans to supplement each municipality's internal contribution and investments. MOHA has started discussions to obtain a sector type loan for this purpose. Since these complementary works, necessary to utilize the project water, are relatively straightforward and MOHA has undertaken to coordinate and assist in financing them, no major problems are envisaged in their implementation between 1985 and 1988. About 30% of these investments have already been appraised for financing by ADB. It is expected that when the complementary works are completed in 1988, the project cities will have a service coverage of about 87% compared to the 77% coverage in 1983, and the smaller municipalities a coverage of about 80% compared to the 50% in 1983.

Treated Water Supply

4. The two existing regional systems supply raw water to eight municipalities. This water is treated by the cities in seven treatment plants, six of which are owned and operated by each of the municipalities concerned, while the seventh is owned and operated by ISWACO. Under the Project an improved system would be constructed which will supply raw water to three jointly owned treatment plants. One new treatment plant would serve six municipalities to the north, a second, ten municipalities to the south and the third (not financed under the project) five municipalities to the west. The other four municipalities will continue to be supplied with raw water due to their location, needs of industry or need to utilize the full capacity of their existing treatment plants. This constitutes a major improvement not only resulting in substantially lower capital and operational costs but also paving the way for similar future expansions and for establishing a better organization for the management of an integrated water supply system for the Metropolitan Region.

KOREA - METROPOLITAN REGION WATER SUPPLY PROJECT

ANNEX 1
TABLE 1

POPULATION AND POPULATION WITH WATER SERVICES IN 1981 IN THE METROPOLITAN REGION 1]

Cities and Towns		Population 1] (1000)	Annual Population Growth 1978-81	Number of Households (1000)	Persons per Household	City Area Km2	Urban Area Square Kms	Urban Density Persons per Ha	Number of Industries	Number Industrial Employees	Year Waterworks were initiated	Population Connected (1000)
Seoul		8676.0	3.5%	1915.1	4.5	627.1	321.4	270.0	7348	476389	1908	8129.4
Incheon	*	1141.7	6.8%	254.2	4.5	201.2	79.1	144.3	1824	217303	1910	1052.6
Suweon	*	324.2	6.8%	71.8	4.5	84.2	28.5	113.7	242	34545	1958	243.2
Seongnam	*	388.2	6.2%	86.5	4.5	141.7	12.2	317.7	402	43570	1973	337.7
Euijeongbu	*	134.9	4.6%	30.5	4.4	81.7	12.7	106.2	39	3498	1964	78.0
Anysng	*	258.5	11.2%	59.3	4.4	58.3	18.5	139.7	372	31931	1966	190.0
Bucheon	*	245.9	14.6%	56.5	4.4	49.3	29.9	82.2	624	31882	1967	164.3
Gwangmyeong	*	154.0		35.1	4.4	36.5	8.4	183.3	82	4958	1974	41.6
Songtan	*	63.3		14.5	4.4	41.3	10.3	61.5	20	2492	1973	49.7
Dongducheon		60.0		12.9	4.7	87.0	11.9	50.3	76	1840	1970	47.0
Banweol	*	41.7	29.0%	9.4	4.4	72.5	7.5	55.6	232	13619	1980	34.2
TOTAL 11 CITIES		11488.5	5.3%	2545.8	4.5	1480.8	540.5	212.6	11261	862007		10367.7
Guri	*	70.1	5.1%	15.9	4.4	30.0	2.5	280.5	131	5842	1973	46.3
Migeum	*	40.6	10.4%	8.9	4.6	46.0	2.3	178.0	66	8573		
Wabu	*	25.0	4.5%	5.4	4.6	93.8	1.2	208.2	38	4297		
Yeoju		24.3	4.1%	5.3	4.6	55.9	2.6	93.4	19	2219	1957	14.7
Pyeongtaek	*	60.5	2.4%	12.4	4.9	27.1	10.3	58.7	43	842	1962	42.7
Paengseong		31.7	-1.8%	7.4	4.3	51.6	3.2	99.1	4	211	1978	26.2
Osan	*	44.6	5.4%	8.7	5.1	39.8	3.5	127.5	60	10330	1975	38.7
Gunpo		39.3	6.1%	9.0	4.4	20.8	3.7	105.7	107	14653		
Euiwang	*	35.2	11.9%	7.3	4.8	48.7	4.2	84.4	70	8092		
Sorae	*	31.5	5.9%	6.7	4.7	55.0	4.9	64.3	72	4899		
Geumchon		23.9	2.9%	5.0	4.8	24.4	1.5	159.1	18	647	1974	14.7
Munsan		30.0	-0.3%	6.3	4.8	34.4	4.6	65.2	16	468	1971	21.5
Junae		20.1	.0%	4.3	4.7	31.9	1.1	182.5	22	1421	1975	10.4
Sindo		56.7	-0.9%	12.5	4.5	70.8	4.4	128.8	100	2225		
Weondang		18.8	2.3%	4.0	4.7	37.3	2.0	93.9	35	1118		
Ilsan		28.5	6.0%	6.2	4.6	30.0	3.5	81.3	13	190		
Byeokje		21.7	2.2%	4.7	4.6	64.1	4.2	51.8	35	1190		
Gwangju		20.0	3.8%	4.1	4.9	57.0	4.6	43.4	41	1913		
Dongbu	*	40.1	11.4%	8.3	4.8	43.6	3.8	105.4	114	4602		
Yeoncheon		12.6	1.2%	2.7	4.7	61.7	2.5	50.3	5	83		
Pocheon		17.8	2.7%	3.8	4.7	34.9	2.3	77.2	26	925	1978	9.0
Gapyeong		18.8	-2.0%	3.9	4.8	145.8	9.0	20.9	21	624	1980	9.0
Yangpyeong		17.1	0.5%	3.7	4.6	41.4	6.7	25.6	26	475	1965	9.0
Icheon		26.3	3.7%	5.8	4.5	27.0	10.7	24.6	28	364	1976	14.2
Janghoweon		17.8	0.5%	3.5	5.1	60.6	7.0	25.6	2	32	1981	0.5
Yongin	*	30.9	7.9%	6.4	4.8	52.6	3.0	102.9	39	3960	1981	3.5
Anseong		32.2	1.9%	6.0	5.4	14.1	6.5	49.6	30	588	1968	22.9
Gimpo	*	20.7	5.7%	4.5	4.6	33.5	2.2	94.1	73	2575		
Ganghwa		21.6	0.4%	5.0	4.3	24.8	3.0	71.9	32	1360	1971	7.0
TOTAL 29 TOWNS		878.2	3.8%	187.7	4.7	1358.6	120.9	72.6	1286	84718		290.3
TOTAL 40 MUNICIP.		12366.7	5.2%	2733.5	4.5	2839.4	661.4	187.0	12547	946725		10658.0

1] Source: Municipal Yearbook of Korea - Ministry of Home Affairs, 1982, and appraisal calculations. The asterisk indicates the municipalities served by the first two and the proposed third regional water supply systems.

03-Aug-84

ANNEX 1
TABLE 2

KOREA - METROPOLITAN REGION WATER SUPPLY PROJECT

WATER SERVICES IN 1981 IN THE METROPOLITAN REGION.

Cities and Towns	Number Water Connections (1000)	% With Water Connections	Persons Per Connection	Water Distribution Network (Kms)	Distribution Networks meters/person	Volume Sold Million Tons per Year	Volume Produced Million Tons per Year	% Unaccounted for Water	Volume Sold per Connect. Tons Per Month	Volume Sold per Person lpcd	Cost of Water Won per Ton
Seoul	896.83	93.7%	9.1	14584.0	1.8	489.234	944.85	48.2%	45.5	165	116
Incheon	106.68	92.2%	9.9	2866.1	2.7	75.035	124.08	39.5%	58.6	195	126
Suweon	23.37	75.0%	10.4	751.2	3.1	10.360	15.00	30.9%	36.9	117	131
Seongnam	29.18	87.0%	11.6	135.7	0.4	15.056	22.21	32.2%	43.0	122	159
Euijeongbu	7.98	57.8%	9.8	60.8	0.8	2.600	3.84	32.3%	27.1	91	73
Anyang	16.53	73.5%	11.5	397.2	2.1	8.288	10.01	17.2%	41.8	120	128
Bucheon	9.67	66.8%	17.0	267.6	1.6	5.041	7.57	33.4%	43.5	84	75
Gwangmyeong	12.28	27.0%	3.4	15.0	0.4	2.208	2.21	0.0%	15.0	145	54
Songtan	4.41	78.5%	11.3	71.0	1.4	2.133	3.03	29.6%	40.3	118	94
Dongducheon	6.32	78.3%	7.4	28.5	0.6	1.719	1.75	1.9%	22.7	100	98
Banweol	5.85	82.1%	5.8	120.7	3.5	3.027	5.11	40.8%	43.1	242	131
TOTAL 11 CITIES	1119.1	90.2%	9.3	19297.7	1.9	614.7	1139.7	46.1%	45.8	162	107.7
Guri	4.14	66.0%	11.2	16.1	0.3	1.637	1.77	7.6%	33.0	97	78
Migeum											
Wabu											
Yeoju	1.58	60.6%	9.3	15.8	1.1	0.734	0.96	23.2%	38.6	137	75
Pyeongtack	3.34	70.5%	12.8	22.8	0.5	2.290	2.34	2.0%	57.2	147	218
Paengseong	0.63	82.6%	41.8	9.5	0.4	0.214	0.26	16.1%	28.5	22	72
Osan	2.19	86.8%	17.7	12.1	0.3	1.179	1.18	0.0%	44.8	83	94
Gunpo											
Euiwang											
Soree											
Geumchon	1.69	61.7%	8.7	35.1	2.4	0.507	0.57	10.3%	25.1	94	227
Munsan	2.96	71.6%	7.2	8.9	0.4	1.124	2.04	45.0%	31.6	143	156
Junae	1.20	51.8%	8.7	7.0	0.7	0.383	0.48	19.9%	26.6	101	206
Sindo											
Weondang											
Ilsan											
Byeokle											
Gwangju											
Dongbu											
Yeoncheon											
Pocheon	1.24	50.5%	7.2	18.8	2.1	0.318	0.33	2.8%	21.4	97	102
Gapyeong	0.60	48.2%	15.0	7.9	0.9	0.147	0.19	20.5%	20.3	45	85
Yangpyeong	0.94	52.8%	9.6	5.4	0.6	0.317	0.35	9.4%	28.1	96	102
Icheon	1.31	54.0%	10.9	26.9	1.9	0.522	0.54	3.3%	33.2	101	79
Janghoweon	0.07	3.0%	7.2	11.9	22.3	0.003	0.53	99.4%	3.4	15	79
Yongin	0.27	11.2%	12.9	7.7	2.2	0.091	0.19	51.5%	28.4	72	177
Anseong	2.39	70.9%	9.5	29.5	1.3	0.934	1.38	32.1%	32.5	112	58
Gimpo											
Ganghwa	1.36	32.4%	5.1	11.7	1.7	0.230	0.29	20.1%	14.1	90	73
TOTAL 29 TOWNS	25.91	33.1%	11.2	247.1	0.9	10.6	13.4	20.5%	34.2	100	118
TOTAL 40 MUNICIP.	1145.0	86.2%	9.3	19544.8	1.8	625.3	1153.0	45.8%	45.5	161	109.4

WATER SERVICES IN 1983 IN THE METROPOLITAN REGION. 1]

Cities and Towns	Population (1000)	Annual Population Growth 1978-83	Annual Population Growth 1981-83	Urban Area Square Kms	Urban Density Persons per Ha	Population Connected (1000)	% With Water Connections	Number Water Connections (1000)	Persons Per Connection	Number Water Employees	Employees per 1000 Connec.	Volume Sold Million Tons per Year	Volume Produced Million Tons per Year	% Unaccounted for Water	Volume Sold per Connect. Tons Per Month	Volume Sold per Person lpcd	Cost of Water Won per Ton	Water Tariff Won per Ton	Cost as % of Revenues
Seoul	9204.3	3.3%	3.0%	321.4	321.4	8857.2	96.2%	1021.73	8.7	3010	2.9	573.18	1102.27	48.0%	46.7	177	92	178	52%
Incheon	1220.3	5.4%	3.4%	78.1	154.3	1134.9	93.0%	115.35	9.8	445	3.9	80.44	127.81	37.1%	58.1	194	143	227	63%
Suweon	373.8	7.0%	7.4%	28.5	131.1	302.8	81.0%	27.36	11.1	109	4.0	15.10	21.42	29.5%	46.0	137	104	147	70%
Seongnam	416.8	5.2%	3.6%	12.2	341.1	367.0	88.1%	36.04	10.2	146	4.1	18.80	23.60	20.3%	43.5	140	138	173	80%
Euijeongbu	145.5	4.3%	3.8%	12.7	114.5	102.0	70.1%	9.91	10.3	57	5.8	4.68	7.19	34.9%	39.4	126	113	174	65%
Anyang	291.9	9.2%	6.3%	18.5	157.8	238.0	81.5%	18.59	12.8	79	4.2	16.35	20.44	20.0%	73.3	198	108	132	80%
Bucheon	340.0	15.8%	17.6%	29.9	113.7	275.0	80.9%	17.38	15.8	61	4.7	12.26	18.03	32.0%	58.8	122	145	213	68%
Gwangmyeong	198.0		13.4%	8.4	235.7	108.0	54.5%	14.78	7.3	38	2.6	2.21	2.55	13.3%	12.5	56	99	170	58%
Songtan	65.2		1.4%	10.3	63.3	52.9	81.1%	5.31	10.0	22	4.1	3.32	4.55	27.0%	52.1	172	90	109	73%
Dongducheon	69.0		7.2%	11.9	57.8	49.0	71.0%	5.38	9.1	36	6.7	2.01	2.56	21.5%	31.1	112	104	132	78%
Banwool	61.4	25.9%	21.4%	7.5	81.9	47.6	77.6%	8.27	5.8	27	3.3	9.50	11.85	20.5%	95.7	544	128	161	79%
TOTAL 11 CITIES	12386.1	4.7%	3.8%	540.5	229.2	11534.4	93.1%	1280.10	9.0	4050	3.2	737.85	1342.4	45.0%	48.0	175	114	165	69%
Guri	77.1	5.0%	4.9%	2.5	308.4	64.0	83.0%	5.05	12.7	18	3.6	2.57	3.04	15.5%	42.4	110	92	109	84%
Higeum	42.5	7.1%	2.3%	2.3	186.3	5.5	13.0%	0.46	12.0	8	17.4	0.24	0.30	20.0%	43.5	120	83	116	80%
Wabu	14.3	-8.2%	-24.3%	1.2	119.2														
Yeoju	24.4	2.5%	0.3%	2.6	93.9	15.0	61.3%	1.70	8.8	13	7.7	0.83	0.99	16.8%	40.8	152	80	107	84%
Pyeongtaek	67.2	3.6%	5.4%	10.3	65.2	45.5	67.7%	3.78	12.0	14	3.7	1.73	2.50	31.0%	38.0	104	97	141	69%
Paengseong	32.1	-0.9%	0.6%	3.2	100.3	11.7	36.5%	1.01	11.6	9	8.9	0.35	0.43	19.4%	28.5	81	108	135	81%
Osan	45.7	3.7%	1.2%	3.5	130.5	32.0	70.0%	2.35	13.6	19	8.1	1.31	1.63	19.6%	46.4	112	87	108	80%
Gunpo]																			
Euiwang]	110.2	34.4%	76.9%	4.2	264.3	36.4	33.0%	0.73	49.8	12	18.4	0.68	0.69	1.4%	77.3	51	101	102	99%
Soraa	27.3	0.5%	-6.9%	4.9	55.7														
Geumchon	33.9	9.1%	19.1%	1.5	225.8	15.1	44.7%	1.89	8.0	30	15.9	0.73	0.85	13.1%	32.4	133	123	141	87%
Hunsan	71.0	18.6%	53.8%	4.6	154.4	34.0	47.8%	4.63	7.4	30	6.5	1.66	2.73	31.9%	33.6	150	88	129	68%
Junae	11.5	-10.5%	-24.3%	1.1	104.7														
Sindo	56.7	-0.5%	.0%	4.4	128.8														
Wandang	19.1	1.7%	0.8%	2.0	95.4														
Ilisan	31.5	5.7%	5.2%	3.5	90.0														
Byeokje	21.4	1.0%	-0.6%	4.2	50.8														
Gwangju	23.1	5.3%	7.5%	4.6	50.2	3.1	13.3%	0.19	16.2	4	21.1	0.07	0.09	20.5%	30.7	82		130	
Dongbu	61.0	16.1%	23.4%	3.8	160.5														
Yeoncheon	12.8	0.8%	0.1%	2.5	50.4	5.7	45.4%	0.41	14.1	6	14.8	0.21	0.23	10.0%	42.5	99	134	149	90%
Pocheon	19.1	2.0%	0.9%	2.3	78.8	9.7	53.8%	1.22	8.0	17	14.0	0.38	0.53	27.2%	26.4	108	108	149	73%
Gapyeong	16.2	-1.6%	-1.6%	9.0	20.2	5.2	28.7%	0.79	6.6	11	13.9	0.31	0.34	9.9%	32.4	162	117	130	90%
Yangpyeong	17.3	0.5%	0.4%	8.7	25.8	9.2	53.3%	1.92	4.8	7	3.8	0.51	0.55	8.8%	22.1	152	112	120	93%
Ichean	28.4	4.5%	5.6%	10.7	27.4	15.9	54.1%	1.75	9.1	12	6.9	1.04	1.20	13.6%	49.3	178	70	81	86%
Janghoweon	16.8	-0.9%	-3.0%	7.0	24.1	2.6	15.2%	0.25	10.2	6	23.9	0.09	0.10	9.6%	31.2	101	110	122	90%
Yongin	33.2	8.2%	3.7%	3.0	110.5	12.1	36.4%	0.92	13.1	12	13.0	0.42	0.61	31.1%	38.0	95	167	196	85%
Anseong	33.0	1.6%	1.2%	8.5	50.8	23.8	72.2%	2.58	9.3	10	3.9	1.11	1.63	31.9%	35.9	128	70	103	68%
Gimpo	22.0	4.7%	3.1%	2.2	100.0	5.9	26.8%	0.59	10.0	8	13.6	0.12	0.13	7.6%	17.1	56	127	159	80%
Ganghwa	21.4	.0%	-0.5%	3.0	71.2	7.0	32.8%	2.81	2.5	13	4.6	0.33	0.39	16.7%	9.8	127	90	109	83%
TOTAL 29 TOWNS	991.7	4.8%	6.3%	117.2	84.6	359.3	36.2%	35.02	10.3	259	7.4	14.88	19.0	21.5%	35.4	113	105	127	82%
TOTAL 40 MUNICIP.	13377.8	4.7%	4.0%	657.7	203.4	11893.7	88.9%	1315.1	9.0	4309	3.3	752.73	1361.3	44.7%	47.7	173	105	140	75%

1] Sources: Draft Yearbook of Water Bureaus in Korea - Ministry of Construction, 1983, and appraisal calculations.

03-Aug-84

KOREA

METROPOLITAN REGION WATER SUPPLY PROJECT

Sanitation and Pollution Control - Existing Facilities and Proposed Improvements

1. About 92% of the population of all municipalities in the Region are served with septic tank and night soil collection facilities. This is the main method of dealing with human wastes and is likely to remain so for some years. Only Seoul City has waterborne sewerage for one densely developed area, with two treatment plants of 360,000 mtpd capacity capable of serving about 25% of its population. Generally, all waste water (except night soil which is collected individually from premises), including septic tank effluent and untreated or partially treated industrial and commercial wastes, is discharged into street drains and water courses. These in turn drain into the Han River, the Anseong River or the sea to the west. Although night soil collection and treatment before disposal is systematic and efficient and all new developments are provided with individual septic tanks or treatment facilities, continuous discharge of partially treated wastes into water courses has seriously impaired water quality in the main water courses. Table 1 shows indicators of water quality in the Han River in 1983 at eight locations downstream of Paldang and indicates a deteriorating situation as the river flows through the main city areas below Dugdo (Map IBRD 18420). The main tributaries draining the developed areas (including Suweon and Anyang, Bucheon and Gwangmyeong), are in poor condition, being practically anaerobic during the dry season (September to July). The situation in the small towns draining into the Anseong River is not so serious, as they are relatively less densely populated. Environmental conditions in neighborhoods are also affected by the scarcity of adequate quantities of water to flush out house and street drains and transfer wastes away from them and into the main water courses.

2. The municipalities maintain fairly extensive systems of street drains, covered and lined main drains and natural water courses to serve as combined sewers. Night soil collection services and treatment plants are also a municipal responsibility. Table 2 gives details of these services in the 40 municipalities in the Region. Garbage collection and disposal services in most municipalities are effectively managed and operated, with landfill and composting being the main disposal methods. Since the outlying areas of the Region are largely agricultural, there is a ready demand for compost and digested nightsoil for application in the fields. Generally, most municipalities maintain a very high standard of neighborhood sanitation compared to similar cities in other developing countries.

3. Air pollution is not a major problem in the smaller municipalities, but Seoul City, Incheon and some of the other cities in the Region are increasingly being affected by atmospheric pollution caused by increasing vehicle use and the lack of emission controls. The traditional use of low grade coal briquettes for heating systems also contributes to this problem.

Sulphur dioxide levels in the main areas of Seoul City have been measured at 0.07 parts per million (ppm) in 1983 and 0.08 ppm in 1984. Although these figures are considerably better than the 0.14 ppm recorded in 1981, and the improvement is attributable to the obligatory use of low sulphur light oil by vehicles in Seoul, they are still in excess of the acceptable standard of 0.05 ppm.

4. Since the estalishment of the Office of the Environment (OOE) in 1980 and the enactment of the Environment Preservation Law in 1981, the OOE and the municipalities have mounted a concerted effort to reduce environmental pollution to acceptable levels and gradually improve the quality of the urban environments which have, over the three previous decades, been impaired by the rapid industrial and population growth. OOE has set and the municipalities are enforcing effluent quality standards for domestic and industrial wastes.

5. The Government has started implementing satisfactory programs to deal with liquid wastes and pollution control based on the Environmental Master Plan Study of the Han River Basin, completed by consultants in 1983. MOHA has prepared a master investment plan for providing interceptor sewers and treatment facilities between 1984 and 1991 in all 49 cities (except Seoul) and 187 towns in the country. This plan, costed at W 243 billion, will be financed out of sewerage tariffs (to be levied in these cities and towns starting in 1985) and government and foreign loans. Nineteen of the project cities and towns will be included in and benefit from this program. Four of the largest cities, Incheon, Bucheon, Anyang and Gwangmyeong, bordering Seoul City, will also benefit from the large-scale improvement works on the Han River being implemented by Seoul City since 1983. These include the training and deepening of the main river and the construction of about 330 km of interceptor sewer along both banks of the river and its main tributaries. This project, estimated to cost over W 500 billion (and financed mainly from revenues from sale of dredging rights), will be completed by 1986. Four sewage treatment plants are also planned (two under construction) for completion in stages by 1996, to provide adequate treatment for dry weather flows from these interceptors before discharge into the Han River. When completed in 1986 the sewer interceptors will contribute to reducing the waste water pollution of the main water courses draining the densely populated project areas to the south of the Han River. OOE is planning to establish a central garbage disposal landfill site to serve the densely populated cities in the project. In addition, OOE has also started programs to control industrial waste pollution of the waterways and atmosphere by establishing effluent and emission standards and monitoring systems and a system of collecting pollution charges. All these measures would result in a gradual improvement of environmental conditions in the project area.

ANNEX 2
Table 1

KOREA

METROPOLITAN REGION WATER SUPPLY PROJECT

Han River: Water Quality Indicators

Location /a	BOD (mg/l)	NH4-N (mg/l)	ABS (mg/l)	Coliform (MPN/100ml)	DO (mg/l)	pH
Paldang	1.1-3.0	0.0.1	0.11-0.31	>100	>6.0	-
Gueui	1.1.3.0	0.0.1	0.11-0.31	>100	>6.0	-
Dugdo	1.1-3.0	0.1-0.5	0.11-0.31	>1,000	>4.0-6.0	-
Bogwang	3.1-6.0	0.5-1.0	0.31-0.50	>10,000	2.0-4.0	-
Noryangjin	3.1-6.0	1.1-5.0	0.51-1.00	>10,000	2.0-4.0	-
Seonju	3.1-5.0	1.1-5.0	0.51-1.00	>10,000	2.0-4.0	-
Yeongduengpo	3.1-6.0	1.1-5.0	0.51-1.00	>10,000	2.0	-
Gayang	>10.0	>5.0	>1.1	>100,000	<2.0	-
Korea standard river water quality /b						
Grade A Class I	< 1.0	-	-	< 100	> 7.5	6.0-8.0
Grade B Class II	< 3.0	-	-	< 1,000	< 7.5	6.0-8.0
Grade C Class III	< 5.0	-	-	< 5,000	< 5.0	5.8-8.5

/a See Map, IBRD 18420.

/b Environmental Preservation Law 1981.
Class I - Water treatment by sand filtration and disinfection.
Class II - Conventional water treatment systems (coagulation, settling, filtration and disinfection).
Class III - Conventional plus sophisticated water treatment systems.

ANNEX 2
Table 2

KOREA - METROPOLITAN REGION WATER SUPPLY PROJECT

SANITATION SERVICES IN 1981 IN THE METROPOLITAN REGION 1]

Cities and Towns	Urban Area Square Kms	Combined Sewerage Networks [Kms]	% of Area Served	# Sewerage Employees	NIGHT SOIL % Population Served	NIGHT SOIL Collection Cu m per day	NIGHT SOIL Treatment Plants [#]	NIGHT SOIL Treatment Capacity Cu m	SEWAGE TREATMENT Treatment Plants [#]	SEWAGE TREATMENT Treatment Capacity Cu m
Seoul	321.4	6790.0	66.8%	425	96.3%	1842	3	2800	2	360000
Incheon	79.1	458.6	65.7%	28	91.8%	296	2	480		
Suweon	28.5	473.1	71.6%	4	97.0%	90	1	5400		
Seongnam	12.2	126.9	69.6%	7	89.9%	180	1	150		
Euijeongbu	12.7	80.3	82.7%	3	78.4%	50				
Anyang	18.5	163.9	82.7%	2	95.5%	88	1	100		
Bucheon	29.9	113.8	64.9%	4	91.2%	79	1	100		
Gwangmyeong	8.4	64.3	54.7%	2	82.4%	24	1	25		
Songtan	10.3	15.8	18.5%	2	80.0%	16	1	624		
Dongducheon	11.9	25.1	52.9%	1	28.6%	40	1	25		
Banweol	7.5	185.0	75.0%	1	47.3%	1				
TOTAL 11 CITIES	540.5	8495.8	66.5%	479	94.5%	2706	12	9704	2	360000
Guri	2.5	11.1	20.0%	3	79.3%	28				
Migeum	2.3	3.4	21.9%	3	64.8%	28				
Wabu	1.2	2.4	25.0%	2	54.6%	12				
Yeoju	2.6	3.2	42.3%	1	63.0%	12				
Pyeongtaek	10.3	38.6	36.9%	33	81.1%	45				
Paengseong	3.2	7.4	21.9%	1	41.5%	37				
Osan	3.5	14.7	57.1%	1	67.6%	14				
Gunpo	3.7	44.6	65.9%	1	74.0%	5				
Euiwang	4.2	0.8	37.9%	1	72.0%	5				
Sorae	4.9	4.7	25.9%		43.0%	5				
Geumchon	1.5	3.1	40.0%	1	42.8%	9				
Munsan	4.6	7.7	32.6%		60.9%	5	1	50		
Junae	1.1	2.1	18.2%	1	62.2%	15				
Sindo	4.4	1.7	4.8%		74.0%	4				
Weondang	2.0	1.5	2.0%	2	48.0%	7				
Iilsan	3.5	1.0	9.1%	1	30.0%	8				
Byeokle	4.2	0.5	0.7%	1	29.0%	6				
Gwangju	4.6	2.6	8.7%	1	65.0%	20				
Dongbu	3.8	2.1	13.2%	2	59.0%	12				
Yeoncheon	2.5	4.2	20.0%		10.0%	1				
Pocheon	2.3	3.8	13.0%	3	64.8%	16				
Gapyeong	9.0	10.6	59.0%	2	55.0%	10				
Yangpyeong	6.7	1.2	11.6%	3	43.3%	10	1	1270		
Icheon	10.7	20.7	49.5%		78.4%	7				
Janghoweon	7.0	2.9	56.3%		40.2%	12				
Yongin	3.0	3.5	76.7%		100.0%	6	1			
Anseong	6.5	11.3	26.9%	1	82.9%	34				
Gimpo	2.2	3.4	45.5%	3	82.4%	43	1	300		
Ganghwa	3.0	3.0	50.0%	4	68.5%	15	2	1529		
TOTAL 29 TOWNS	120.9	217.5	33.6%	71	64.0%	431	6	3149	0	0
TOTAL 40 MUNICIP.	661.4	8714.3	60.4%	550	92.3%	3137	18	12853	2	360000

1] Source: Municipal Yearbook of Korea - Ministry of Home Affairs, 1982, and appraisal calculations.

ANNEX 3
TABLE 1

KOREA – METROPOLITAN REGION WATER SUPPLY PROJECT

POPULATION IN THE MUNICIPALITIES SERVED BY REGIONAL WATER SUPPLY SYSTEMS 1]

Cities, Towns (Eubs), and Villages (Myeon)	GOVERNMENT DEVELOPMENT PLAN 2]	POPULATION (1000 PERSONS)						ANNUAL POPULATION GROWTH RATES				
		1971	1981	1983	1988	1991	1996	1971-81	1981-83	1983-88	1988-91	1991-96
Incheon		871	1142	1220	1456	1619	1832	5.5%	3.4%	3.6%	3.8%	2.5%
Bucheon		58	248	340	548	680	848	15.8%	17.6%	10.0%	7.5%	4.5%
Gwangmyeong		46	154	198	319	396	492	12.8%	13.4%	10.0%	7.5%	4.0%
Sorae				27	35	40	47			5.1%	4.5%	3.5%
Gimpo	Relocation			22	26	28	31			3.5%	2.8%	1.5%
INCHEON SYSTEM		775	1542	1808	2384	2764	3240	7.1%	8.3%	5.7%	5.1%	3.2%
Anyang		102	258	292	382	442	537	9.8%	6.3%	5.5%	5.0%	4.0%
Euiwang/Gunpo (Eub)		25	75	110	147	173	206	11.5%	21.6%	6.0%	5.5%	3.5%
Dongbu (Eub)		19	40	61	89	107	131	7.6%	23.4%	7.8%	6.5%	4.0%
Banwool & new dev. areas	Promoted	15	42	61	135	189	253	10.9%	21.3%	17.0%	12.0%	6.0%
INDEPENDENT RAW WATER SYSTEMS		161	415	525	752	911	1127	9.9%	12.5%	7.5%	6.6%	4.3%
Seongnam		159	388	417	456	474	500	9.3%	3.6%	1.8%	1.3%	1.1%
Suweon		176	324	374	500	579	704	6.3%	7.3%	8.0%	5.0%	4.0%
Songtan	Promoted	52	63	68	100	126	172	2.0%	3.6%	8.0%	8.0%	6.5%
Pyeng Taek Devel. area	Promoted				70	147	283				28.0%	14.0%
Osan (Eub)		24	45	46	58	66	78	6.6%	1.2%	5.0%	4.0%	3.5%
Yongin (Eub)	Preservat.	14	31	33	43	48	55	8.1%	3.7%	5.3%	3.5%	3.0%
Tasan (Myeon)		14	23	23	30	34	40	5.3%	0.9%	5.0%	4.0%	3.5%
Giheung (Myeon)		10	21	23	29	33	40	7.5%	3.3%	5.0%	4.5%	4.0%
Dongtan (Myeon)		9	14	14	17	19	22	4.1%	1.1%	4.0%	3.5%	3.2%
Jinwee (Myeon)		8	11	12	15	16	19	3.4%	3.8%	4.0%	3.8%	3.2%
SEONGNAM SYSTEM		466	921	1010	1318	1540	1914	7.0%	4.7%	5.5%	5.3%	4.4%
Euijeongbu	Relocation	95	135	145	173	189	211	3.6%	3.8%	3.5%	3.1%	2.2%
Guri (Eub)	Relocation	30	70	77	97	106	119	8.8%	4.9%	4.7%	3.1%	2.2%
Migeum (Eub)	Relocation	18	41	42	53	58	65	8.3%	2.3%	4.7%	3.1%	2.2%
Byeolnae (Myeon)		17	19	19	22	23	26	1.1%	0.5%	2.6%	2.0%	2.0%
Wabu (Eub)	Restricted	21	20	18	21	22	23	-0.5%	-5.1%	3.0%	2.1%	0.9%
Jingeon (Myeon)		9	11	12	13	14	16	2.1%	2.5%	2.4%	2.0%	2.0%
EUIJEONGBU SYSTEM		191	296	314	379	414	459	4.5%	3.0%	3.8%	2.9%	2.1%
TOTAL 25 MUNICIP. IN PROJECT		1592	3173	3656	4833	5630	6740	7.1%	7.3%	5.7%	5.2%	3.7%
Seoul (Not in Project)	Restricted	5859	8678	9204	10113	10574	11169	4.0%	3.0%	1.9%	1.5%	1.1%
Gwacheon (Not in Project)		10	15	61	71	77	85	4.6%	101.7%	3.0%	3.0%	2.0%
TOTAL 27 MUNICIPALITIES		7461	11864	12921	15017	16281	17995	4.7%	4.4%	3.1%	2.7%	2.0%

1] Source: Feasibility Study Metropolitan Water Supply Project (Nihon Suido-KECC) and appraisal estimates

2] The expansion of the municipalities is promoted or restricted based on incentives or heavy taxes . In relocation areas new construction is taxed at 500% normal rates and industry is to be relocated. In promoted zones fiscal incentives are given. Industrial development is prohibited in areas for nature preservation . The area near the border with North Korea are restricted or reserved for special development.

ANNEX 3
TABLE 2

KOREA - METROPOLITAN REGION WATER SUPPLY PROJECT

PER CAPITA WATER CONSUMPTION AND POPULATION SERVED BY REGIONAL WATER SUPPLY SYSTEMS

Cities, Towns (Eubs), and Villages (Myeon)	% POPULATION CONNECTED				POPULATION CONNECTED (1000)				PER CAPITA CONSUMPTION (lpcd)			
	1983	1988	1991	1996	1983	1988	1991	1996	1983	1988	1991	1996
Incheon	93.0%	94.0%	95.0%	98.0%	1135	1389	1538	1758	194	215	225	230
Bucheon	81.0%	89.0%	94.0%	98.0%	275	487	639	814	122	170	200	230
Gwangmyeong	55.0%	85.0%	93.0%	95.0%	109	271	368	458	37	170	200	230
Sorae	34.0%	74.0%	80.0%	85.0%	9	26	32	40	135	160	180	210
Gimpo	27.0%	74.0%	80.0%	90.0%	6	19	23	28	58	160	180	210
INCHEON SYSTEM	84.8%	91.1%	94.1%	95.6%	1534	2173	2601	3098	169	198	214	230
Anyang	81.5%	89.0%	95.0%	96.0%	238	340	420	516	188	188	210	230
Euiwang/Gunpo (Eub)	33.0%	84.0%	90.0%	92.0%	36	124	156	189	52	160	180	210
Dongbu (Eub)	58.4%	80.0%	80.0%	85.0%	34	71	86	111	81	140	170	190
Banwool & new dev. areas 1]	78.0%	90.0%	95.0%	95.0%	48	121	180	240	544	300	300	300
INDEPENDENT RAW WATER SYSTEMS	68.0%	87.1%	92.3%	93.8%	357	656	841	1056	212	259	315	314
Seongnam	88.0%	91.4%	95.0%	96.0%	367	416	450	480	140	174	200	200
Suweon	81.0%	90.0%	94.0%	96.0%	303	450	544	676	137	177	200	230
Songtan	81.0%	84.0%	90.0%	92.0%	55	84	113	159	172	180	200	230
Pyong Taek Devel. area 2]		70.0%	85.0%	90.0%	0	49	125	254		180	220	230
Osan (Eub)	70.0%	77.0%	80.0%	85.0%	32	45	52	66	112	160	180	210
Yongin (Eub)	36.0%	50.0%	70.0%	75.0%	12	21	33	41	119	160	180	210
Tasan (Myeon)		24.0%	70.0%	75.0%	0	7	24	30	0	120	140	170
Giheung (Myeon)	8.0%	34.0%	70.0%	75.0%	2	10	23	30	113	120	140	170
Dongtan (Myeon)		44.0%	70.0%	75.0%	0	7	13	17	0	120	140	170
Jinwee (Myeon)		44.0%	70.0%	75.0%	0	6	11	14	0	120	140	170
SEONGNAM SYSTEM 2]	76.3%	83.2%	90.2%	92.4%	770	1097	1389	1768	140	201	241	274
Euijeongbu	70.0%	88.0%	93.0%	95.0%	102	152	176	201	126	185	210	210
Guri (Eub)	63.0%	75.0%	85.0%	92.0%	48	73	90	109	110	160	180	210
Migeum (Eub)	12.8%	74.0%	80.0%	85.0%	5	40	47	55	121	160	180	210
Byeolnae (Myeon)		74.0%	80.0%	85.0%	0	16	19	22	0	120	140	170
Wabu (Eub)	41.0%	65.0%	75.0%	85.0%	7	14	17	20	115	120	170	210
Jingeon (Myeon)		54.0%	70.0%	80.0%	0	7	10	13	0	120	140	170
EUIJEONGBU SYSTEM	52.0%	79.4%	86.6%	91.2%	163	301	358	419	120	168	191	207
TOTAL 25 MUNIC.IN PROJECT	77.3%	87.4%	92.2%	94.1%	2824	4226	5190	6342	164	206	236	255
Seoul (Not in Project)	96.2%	97.0%	98.0%	99.0%	8855	9809	10363	11057	177	210	220	230
Gwachon (Not in Project)	77.6%	85.0%	90.0%	95.0%	47	60	70	81	155	200	220	230
TOTAL 27 MUNICIPALITIES	90.8%	93.9%	96.0%	97.1%	11726	14096	15622	17481	174	209	225	239

1] Includes 40,000 mtpd 1988, and 80,000 mtpd in 1991 for the new Banwool industrial zone.

2] In addition to the population demand, includes 30,000 mtpd in 1988, 60,000 mtpd in 1991 and 80,000 mtpd in 1996 for new industrial areas.

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ANNEX 3
TABLE 3

KOREA - METROPOLITAN REGION WATER SUPPLY PROJECT

WATER PRODUCED AND SOLD BY REGIONAL WATER SUPPLY SYSTEMS

Cities, Towns (Eubs), and Villages (Myeon)	WATER SOLD (1000 mtpd)				% UNACCOUNTED-FOR WATER				AVG WATER PRODUCTION 1000 mtpd			
	1983	1988	1991	1996	1983	1988	1991	1996	1983	1988	1991	1996
Incheon	220.4	284.3	346.1	404.5	37%	34%	30%	28%	350.2	446.0	494.5	561.9
Bucheon	33.6	82.8	127.9	187.2	32%	28%	28%	28%	48.4	115.1	177.6	260.0
Gwangyeong	4.1	46.1	73.7	105.3	42%	30%	28%	28%	7.0	65.8	102.3	146.3
Soree	1.3	4.1	5.8	8.5	25%	25%	25%	25%	1.7	5.5	7.7	11.3
Gimpo	0.3	3.1	4.1	5.8	20%	25%	25%	25%	0.4	4.1	5.5	7.7
INCHEON SYSTEM	259.6	430.5	557.6	711.3	36%	32%	29%	28%	408.6	636.5	787.8	987.1
Anyang	44.8	63.8	88.1	118.8	20%	25%	25%	25%	56.0	85.1	117.5	158.2
Euiwang/Gunpo (Eub)	1.9	19.8	28.1	39.7	20%	25%	25%	25%	2.3	26.4	37.4	53.0
Dongbu (Eub)	2.8	9.9	14.6	21.1	25%	25%	25%	25%	3.7	13.3	19.5	28.1
Banwool & new dev. areas 1]	26.1	76.3	133.9	152.1	20%	25%	25%	25%	32.6	101.8	178.5	202.8
INDEPENDENT RAW WATER SYSTEMS	75.5	170.0	264.7	331.6	20%	25%	25%	25%	94.6	226.6	352.9	442.1
Seongnam	51.5	72.5	90.0	96.1	20%	25%	25%	25%	64.7	96.6	120.0	128.1
Suweon	41.4	79.7	108.8	155.5	30%	30%	28%	28%	58.7	113.8	151.1	216.0
Songtan	9.5	15.1	22.7	36.5	27%	28%	28%	28%	13.0	21.0	31.5	50.7
Pyeng Taek Devel. area 2]	0.0	38.8	87.5	158.5		25%	25%	25%	0.0	51.8	116.6	211.3
Osan (Eub)	3.6	7.2	9.4	13.9	20%	25%	25%	25%	4.5	9.6	12.6	18.5
Yongin (Eub)	1.4	3.4	6.0	8.7	15%	25%	25%	25%	1.7	4.6	8.0	11.6
Taean (Myeon)	0.0	0.9	3.3	5.1	0%	25%	25%	25%	0.0	1.1	4.4	6.8
Giheung (Myeon)	0.2	1.2	3.3	5.2	25%	25%	25%	25%	0.3	1.6	4.3	6.9
Dongtan (Myeon)	0.0	0.9	1.8	2.8	0%	25%	25%	25%	0.0	1.2	2.5	3.8
Jinwee (Myeon)	0.0	0.8	1.6	2.4	0%	25%	25%	25%	0.0	1.0	2.1	3.3
SEONGNAM SYSTEM	107.6	220.4	334.4	484.7	25%	27%	26%	26%	142.8	302.3	453.1	656.9
Euijeongbu	12.8	28.1	37.0	42.1	35%	30%	28%	28%	19.7	40.2	51.4	58.5
Guri (Eub)	5.3	11.6	16.3	22.9	15%	25%	25%	25%	6.3	15.5	21.7	30.5
Migeum (Eub)	0.7	6.3	8.4	11.7	19%	25%	25%	25%	0.8	8.4	11.2	15.5
Byeolnae (Myeon)	0.0	1.9	2.6	3.7	0%	25%	25%	25%	0.0	2.6	3.5	4.9
Wabu (Eub)	0.8	1.6	2.8	4.1	25%	25%	25%	25%	1.1	2.2	3.8	5.5
Jingeon (Myeon)	0.0	0.9	1.4	2.1	0%	25%	25%	25%	0.0	1.2	1.9	2.8
EUIJEONGBU SYSTEM	19.7	50.5	68.5	86.6	30%	28%	27%	26%	28.0	70.0	93.4	117.9
TOTAL 25 MUNIC.IN PROJECT	462.4	871.4	1225.1	1614.2	31%	29%	27%	27%	674.0	1235.4	1687.0	2204.0
Seoul (Not in Project)	1570.4	2059.9	2279.9	2543.2	48%	40%	33%	30%	3019.8	3433.2	3402.8	3633.1
Gwachon (Not in Project)	7.3	12.0	15.3	18.6	29%	25%	25%	25%	10.3	16.0	20.4	24.8
TOTAL 27 MUNICIPALITIES	2040.1	2943.3	3520.2	4176.0	45%	37%	31%	29%	3704.3	4684.7	5110.1	5861.9

1] Includes 40,000 mtpd 1988, and 80,000 mtpd in 1991 for the new Banwool industrial zone
2] In addition to the population demand, includes 30,000 mtpd in 1988, 80,000 mtpd in 1991 and 80,000 mtpd in 1996 for new industrial areas.

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ANNEX 3
TABLE 4

KOREA - METROPOLITAN REGION WATER SUPPLY PROJECT

PEAK DEMAND, DEFICIT AND ALLOCATION OF WATER IN THE REGIONAL WATER SUPPLY SYSTEMS

THOUSAND METRIC TONS PER DAY

Cities, Towns [Eubs], and Villages [Myeon]	— MAXIMUM DAILY DEMAND 1] —				PRODUCTION CAPACITY IN 1983		PRODUCTION CAPACITY IN 1988		WATER DEFICIT [-] OR SURPLUS [+] BY				WATER ALLOCATED FROM PROJECT
	1983	1988	1991	1996	OWN SOURCES	METRO I & II	OWN SOURCES	METRO I & II	1983	1988	1991	1996	
Incheon	438	557	618	702	20.0	350.0	130.0	370.0	-67.7	-57.4	-118.1	-202.3	220.0
Bucheon	62	144	222	325		50.0		50.0	-11.8	-83.8	-172.0	-275.0	200.0
Gwangmyeong	9	82	128	183	19.0		19.0		10.3	-63.3	-108.9	-163.8	120.0
Sorae	2	7	10	14	2.0		2.0		-0.1	-4.8	-7.6	-12.1	10.0
Gimpo	1	5	7	10	0.6		0.6		0.1	-4.6	-6.2	-9.0	10.0
INCHEON SYSTEM	511	796	984	1234	41.6	400.0	151.6	420.0	-69.2	-224.0	-412.8	-682.3	560.0
Anyang	70	108	147	198		50.0		77.0	-20.0	-29.4	-69.9	-120.7	80.0
Euiwang/Gunpo [Eub]	3	33	47	66	4.0		4.0	23.0	1.1	-6.0	-19.8	-39.2	15.0
Dongbu [Eub]	5	17	24	35	4.0		4.0		-0.6	-12.6	-20.3	-31.1	20.0
Banwool & new dev. areas	41	127	223	254		150.0		150.0	109.3	22.8	-73.2	-103.6	100.0
INDEPENDENT RAW WATER SYSTEMS	118	283	441	553	8.0	200.0	8.0	250.0	89.7	-25.3	-183.1	-294.7	215.0
Seongnam	81	121	150	160		50.0		100.0	-30.8	-20.8	-50.0	-60.1	50.0
Suweon	73	142	189	270		100.0		100.0	26.6	-42.2	-88.9	-170.0	120.0
Songtan	16	26	39	63			15.0		-16.3	-11.2	-24.3	-48.3	20.0
Pyong Taek Devel. area	0	65	146	264					0.0	-64.7	-145.8	-264.2	200.0
Osan [Eub]	6	12	16	23			10.0		-5.6	-2.0	-5.7	-13.2	10.0
Yongin [Eub]	2	6	10	14			4.0		-2.1	-1.7	-6.0	-10.5	10.0
Taean [Myeon]	0	1	5	8					0.0	-1.4	-5.5	-8.5	5.0
Giheung [Myeon]	0	2	5	9	2.0		3.0		1.7	1.0	-2.4	-5.6	5.0
Dongtan [Myeon]	0	1	3	5					0.0	-1.5	-3.1	-4.7	3.0
Jinwee [Myeon]	0	1	3	4					0.0	-1.3	-2.7	-4.1	2.0
SEONGNAM SYSTEM	178	378	566	821	2.0	150.0	32.0	200.0	-26.5	-145.8	-334.4	-589.1	425.0
Euijeongbu	25	50	64	73	24.0		24.0		-0.6	-26.2	-40.2	-48.1	50.0
Guri [Eub]	8	19	27	38	9.0		9.0		1.1	-10.4	-18.1	-29.2	26.0
Migeum [Eub]	1	11	14	19	2.5		7.5		1.5	-3.0	-6.6	-11.9	11.0
Byeolnae [Myeon]	0	3	4	6					0.0	-3.2	-4.3	-6.2	6.0
Wabu [Eub]	1	3	5	7	2.0		3.0		0.6	0.3	-1.7	-3.9	4.0
Jingeon [Myeon]	0	1	2	4					0.0	-1.4	-2.3	-3.6	3.0
EUIJEONGBU SYSTEM	35	88	117	147	37.5	0.0	43.5	0.0	2.5	-44.1	-73.2	-103.8	100.0
TOTAL 25 MUNIC.IN PROJECT	843	1544	2109	2755	89.1	750.0	235.1	870.0	-3.4	-439.2	-1003.6	-1649.9	1300.0
Seoul [Not in Project]	3775	4292	4253	4541	1900.0	1717.0	3200.0	1717.0	-157.9	625.5	683.5	375.6	
Gwacheon [Not in Project]	13	20	26	31		30.0		30.0	17.1	10.0	4.5	-1.1	
TOTAL 27 MUNICIPALITIES	4630	5858	6388	7327	1989.1	2497.0	3435.1	2617.0	-144.2	196.3	-335.6	-1275.3	1300.0

1] The maximum daily demand is 1.25 times the average water production.

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ANNEX 3
TABLE 5

KOREA - METROPOLITAN REGION WATER SUPPLY PROJECT

POPULATION BENEFITED, AVERAGE WATER DEMAND AND WATER SUPPLIED BY THE PROJECT (Thousand mtpd)

A) INCHEON SYSTEM

YEAR	TOTAL POPU-LATION 1000	POPU-LATION SERVED 1000	AVG DEMAND	SUPPLY FROM OTHER SOURCES	SUPPLIED BY THE PROJECT	INCRE-MENTAL POPUL. BENEFIT.
1983	1808	1534	409	397		
1984	1910	1645	447	397		
1985	2019	1763	488	397		
1986	2134	1890	533	397		
1987	2256	2027	583	397		
1988	2384	2173	637	514		
1989	2503	2306	683	514	168	206
1990	2629	2447	733	514	218	347
1991	2764	2601	788	514	273	501
1992	2853	2694	824	514	310	594
1993	2945	2790	862	514	348	690
1994	3040	2889	902	514	387	789
1995	3139	2992	944	514	429	892
1996	3240	3098	987	514	473	999

B) INDEPENDENT RAW WATER SYSTEMS

TOTAL POPU-LATION 1000	POPU-LATION SERVED 1000	AVG DEMAND	SUPPLY FROM OTHER SOURCES	SUPPLIED BY THE PROJECT	INCRE-MENTAL POPUL. BENEFIT.
525	357	95	95		
564	403	113	113		
606	455	134	134		
651	514	160	160		
700	580	190	187		
752	656	227	227		
802	712	262	232	30	84
854	773	304	232	71	155
911	841	353	232	121	223
951	880	369	232	137	262
992	921	386	232	154	303
1035	964	404	232	172	346
1080	1009	423	232	190	391
1127	1056	442	232	204	438

C) SEONGNAM SYSTEM

YEAR	TOTAL POPU-LATION 1000	POPU-LATION SERVED 1000	AVG DEMAND	SUPPLY FROM OTHER SOURCES	SUPPLIED BY THE PROJECT	INCRE-MENTAL POPUL. BENEFIT.
1983	1010	770	143	137		
1984	1065	827	166	137		
1985	1123	887	193	137		
1986	1184	952	224	137		
1987	1249	1022	260	137		
1988	1318	1097	302	209		
1989	1388	1187	346	209	137	127
1990	1462	1284	398	209	187	225
1991	1540	1389	453	209	244	330
1992	1609	1458	488	209	279	399
1993	1680	1530	526	209	317	471
1994	1755	1606	566	209	357	546
1995	1833	1685	610	209	401	626
1996	1914	1768	657	209	404	709

D) EUIJEONGBU SYSTEM

TOTAL POPU-LATION 1000	POPU-LATION SERVED 1000	AVG DEMAND	SUPPLY FROM OTHER SOURCES	SUPPLIED BY THE PROJECT	INCRE-MENTAL POPUL. BENEFIT.
314	163	28	28		
326	185	34	34		
339	209	40	34		
352	236	49	34		
365	267	58	34		
379	301	70	39		
390	319	77	39	38	35
402	338	85	39	46	54
414	358	93	39	54	75
423	370	98	39	59	86
431	382	102	39	63	98
441	394	107	39	68	110
450	406	113	39	73	122
458	419	118	39	79	135

21-Aug -84

ANNEX 3
TABLE 6

KOREA - METROPOLITAN REGION WATER SUPPLY PROJECT

POPULATION AND DEMAND SUMMARY FOR THE WHOLE PROJECT

YEAR	TOTAL POPU- LATION 1000	POPU- LATION SERVED 1000	VOLUME CONSU- MED 1000 mtpd	CONSUMP- TION PER CAPITA lpcd	AVG DEMAND 1000 mtpd	SUPPLIED FROM OTHER SOURCES	SUPPLIED BY THE PROJECT 1000 mtpd	INCRE- MENTAL POPUL. BENEFIT. 1000
1983	3656	2824	462	164	674	657		
1984	3865	3059	525	172	759	681		
1985	4087	3314	596	180	855	702		
1986	4322	3592	676	188	965	728		
1987	4570	3896	768	197	1091	755		
1988	4833	4226	871	206	1235	989		
1989	5083	4523	976	216	1368	995	374	482
1990	5346	4841	1093	226	1517	995	522	780
1991	5630	5190	1225	236	1687	995	692	1129
1992	5836	5402	1295	240	1779	995	784	1341
1993	6049	5623	1368	243	1876	995	882	1562
1994	6271	5853	1446	247	1979	995	985	1792
1995	6501	6092	1528	251	2089	995	1094	2031
1996	6740	6342	1614	255	2204	995	1159	2281

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KOREA

METROPOLITAN REGION WATER SUPPLY PROJECT

Project Description

General

1. The project is the third bulk water supply system in the Metropolitan Region. The two existing systems, completed in 1978 and 1981 respectively, supply bulk raw water to Seoul and seven other cities in the Region (Map IBRD 18420).

2. The Project consists of:

(a) a main raw water transmission system extracting water from the existing Paldang reservoir on the Han River upstream of Seoul City and transmitting through pipelines, tunnels and pumping stations to supply (i) raw water for two new treated water systems of 560,000 and 425,000 metric tons per day (mtpd) capacity each, designed to serve (a) the five western regional cities of Incheon (fourth largest city in Korea), Bucheon and Gwangmyeong and the towns of Sorae and Gimpo; and (b) the ten southern municipalities including Suweon, Seongnam and Songtan and a new planned industrial development area around Pyeongtaek; and (ii) 215,000 mtpd of raw water to three municipalities to supplement existing services, and to provide raw water to the new Banweol industrial area; and [1/]

(b) an additional river intake about 5 km downstream of Paldang supplying water to a new treated water system with a capacity of 100,000 mtpd designed to serve Euijeongbu and another five municipalities in the northern area of the Region.

3. Main Project Physical Works are:

(a) Main raw water transmission system:

- a main channel type intake from the Paldang Reservoir designed for 2.4 million mtpd capacity, which is the design capacity for the year 2000, and twice the capacity required for the project (1.2 million mtpd);

- an intake pumping station at Paldang equipped, in a first stage, with four 250,000 mtpd pumping units (including standby) at 76 m head, and an administration and control building for centralized monitoring and control of all three Metropolitan Region water

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1/ The treatment plant for Incheon, Bucheon and Gwangmyeong is not included in the project and would be financed by ADB and the municipalities.

supply systems;

- 39 km of main transmission line comprising 11 km of twin pipeline 2,200 mm in diameter and 28 km single pipeline varying between 2,400 mm and 1,650 mm in diameter, and 13.0 km in six tunnels between 3,800 mm and 3,000 mm in diameter, delivering water from the Paldang intake to a common treatment plant for Incheon/Bucheon/ Gwangmyeong cities sited between Bucheon and Gwangmyeong;

- a booster pumping station downstream of the fourth tunnel equipped with four 140,000 mtpd pumping units (including standby) at 25 m head;

(b) Seongnam Treated Water System

- a branch pipeline 9 km long, 1,800 mm diameter, from Suseo junction on the main transmission line to the new treatment plant at Seongnam;

- a new treatment plant 425,000 mtpd capacity with a booster pumping station equipped with four 88,000 mtpd pumping units (including standby) at 55 m head;

- a main treated water transmission line 40 km long varying between 1,800 mm and 1,350 mm in diameter from Seongnam to Pyeongtaek serving ten municipalities, in the southern areas of the Region including new planned industrial development in the Pyongtaek area; and

(c) Euijeongbu treated water system

- an intake and pumping station near Wabu on the Han River about 5 km downstream of the Paldang dam. Intake capacity 100,000 mtpd with a pumping station equipped with three 36,000 mtpd pumping units (including standby) at 8 m head;

- a raw water transmission pipeline 6 km long, 1,100 mm in diameter;

- a new treatment plant of 100,000 mtpd capacity;

- a main treated water transmission pipeline serving some 6 municipalities, 19 km long varying between 1,100 mm and 900 mm diameter; and

- a booster pumping station at Migeum equipped with four pumping units of 23,500 mtpd capacity each (including standby) at 65 m head.

4. Consultant services for project engineering and supervision to assist the Project Unit established by MOC. About 30 manmonths of foreign and 520 manmonths of local consultant support would be provided by KECC to the Project Unit for detailed engineering, preparation of bidding documents, bid evaluation, construction design and supervision. Locally financed studies to be completed during project execution include the study on bulk water tariffs (Annex 13) and improvement of ISWACO's corporate planning, to be implemented by ISWACO, and on the water and sewerage organization in the Metropolitan Region, to be implemented by MOHA (Annex 14).

METROPOLITAN REGION WATER SUPPLY PROJECT ANNEX 5

DETAILED PROJECT COST

WORKS	MILLION WON			% OF BASE COST	MILLION US$			%	MILLION US$			
	Local	Foreign	Total		Local	Foreign	Total	Foreign	1985	1986	1987	1988
1] RAW WATER COMPONENTS:	30327	23248	53575	34.06%	37.91	29.06	66.97	43.4%	11.72	20.64	21.93	12.68
CIVIL WORKS:	22051	9243	31294	19.90%	27.56	11.55	39.12	29.5%	9.24	13.89	11.74	4.45
Paldang Int.& Pump.Station	8507	2838	11343	7.21%	10.63	3.54	14.18	25.0%	4.25	4.96	4.25	0.71
Paldang-Gusoo Trans.Pipeline	5415	2003	7418	4.72%	6.77	2.50	9.27	27.0%	1.85	3.25	2.78	1.39
Tunnels 1 & 3	6082	4404	10486	6.67%	7.60	5.51	13.11	42.0%	2.62	4.59	3.33	1.97
Taxes and Duties	2047	0	2047	1.30%	2.56	0.00	2.56	0.0%	0.51	0.90	0.77	0.38
EQUIPMENT AND MATERIALS	8276	14005	22281	14.17%	10.35	17.51	27.85	62.9%	2.48	6.94	10.20	8.23
Pipes and Fittings	3280	6055	9315	5.92%	4.08	7.57	11.64	65.0%	2.33	4.08	3.49	1.75
Pumps and Motors	398	929	1327	0.84%	0.50	1.16	1.66	70.0%	0.00	0.50	0.83	0.33
Electrical & Substation	685	1599	2284	1.45%	0.86	2.00	2.86	70.0%	0.00	0.43	1.14	1.28
Controls	741	4199	4940	3.14%	0.93	5.25	6.18	85.0%	0.00	0.31	2.78	3.09
Other equipment	816	1223	2039	1.30%	1.02	1.53	2.55	60.0%	0.00	0.89	0.78	0.89
Taxes and Duties	2376	0	2376	1.51%	2.97	0.00	2.97	0.0%	0.15	0.74	1.19	0.89
2] INCHEON SYSTEM	17940	12692	30632	19.48%	22.43	15.86	38.29	41.4%	4.32	11.94	14.19	7.84
CIVIL WORKS	14341	6473	20814	13.23%	17.93	8.09	26.02	31.1%	3.35	7.86	9.19	5.51
Main Transmission Pipe.	6187	2289	8476	5.39%	7.73	2.86	10.60	27.0%	1.59	3.18	3.71	2.12
Tunnels 4 & 8	4822	3564	8486	5.40%	6.15	4.46	10.61	42.0%	1.59	3.18	3.71	2.12
Booster Pumping Station	1880	620	2480	1.58%	2.33	0.78	3.10	25.0%	0.00	1.09	1.09	0.93
Taxes and Duties	1372	0	1372	0.87%	1.72	0.00	1.72	0.0%	0.17	0.51	0.89	0.34
EQUIPMENT AND MATERIALS	3599	6219	9818	6.24%	4.50	7.77	12.27	63.3%	0.97	3.98	5.00	2.33
Pipes & Fittings	2736	4865	7801	4.83%	3.42	6.08	9.50	64.0%	0.95	3.33	3.80	1.43
Pumps and Motors	157	367	524	0.33%	0.20	0.46	0.66	70.0%	0.00	0.20	0.33	0.13
Electrical & Substation	68	158	226	0.14%	0.08	0.20	0.28	70.0%	0.00	0.04	0.11	0.13
Controls	59	333	392	0.25%	0.07	0.42	0.49	85.0%	0.00	0.02	0.22	0.25
Other equipment	331	498	827	0.53%	0.41	0.62	1.03	60.0%	0.00	0.31	0.41	0.31
Taxes and Duties	248	0	248	0.16%	0.31	0.00	0.31	0.0%	0.02	0.08	0.12	0.09
3] SEONGTAN SYSTEM:	24883	17421	42304	26.90%	31.10	21.78	52.88	41.2%	7.63	15.92	16.75	12.58
CIVIL WORKS	18509	6036	24545	15.61%	23.14	7.55	30.69	24.6%	4.80	9.20	9.20	7.67
Main Transmission Pipeline	10235	3785	14020	8.91%	12.79	4.73	17.53	27.0%	2.63	5.26	5.26	4.38
Treatment Plant & BPS	6753	2251	9004	5.72%	8.44	2.81	11.26	25.0%	1.69	3.38	3.38	2.81
Taxes and Duties	1521	0	1521	0.97%	1.90	0.00	1.90	0.0%	0.29	0.57	0.57	0.48
EQUIPMENT AND MATERIALS	6374	11385	17758	11.29%	7.97	14.23	22.20	64.1%	3.03	6.71	7.54	4.91
Pipes & Fittings	4224	7508	11732	7.46%	5.28	9.39	14.67	64.0%	2.93	5.13	4.40	2.20
Pumps and Motors	215	503	718	0.46%	0.27	0.63	0.90	70.0%	0.00	0.27	0.45	0.18
Electrical & Substation	258	603	862	0.55%	0.32	0.75	1.08	70.0%	0.00	0.16	0.43	0.48
Controls	248	1408	1656	1.05%	0.31	1.76	2.07	85.0%	0.00	0.10	0.93	1.04
Other equipment	908	1363	2271	1.44%	1.14	1.70	2.84	60.0%	0.00	0.85	1.14	0.85
Taxes and Duties	520	0	520	0.33%	0.65	0.00	0.65	0.0%	0.10	0.20	0.20	0.16
4] EUIJEONGBU SYSTEM	10199	8091	18290	11.63%	12.75	10.11	22.86	44.2%	2.64	8.14	7.70	6.37
CIVIL WORKS	7445	2752	10197	6.48%	9.31	3.44	12.75	27.0%	1.91	3.82	3.82	3.19
Intake & Pumping Station	835	278	1113	0.71%	1.04	0.35	1.39	25.0%	0.21	0.42	0.42	0.35
Water Treatment Plant	2231	744	2975	1.89%	2.79	0.93	3.72	25.0%	0.56	1.12	1.12	0.93
Booster Pumping Station	482	161	643	0.41%	0.60	0.20	0.80	25.0%	0.12	0.24	0.24	0.20
Main Transmission Pipeline	2321	859	3180	2.02%	2.90	1.07	3.98	27.0%	0.60	1.19	1.19	0.99
Tunnel	982	711	1693	1.08%	1.23	0.89	2.12	42.0%	0.32	0.63	0.63	0.53
Taxes and Duties	583	0	583	0.38%	0.74	0.00	0.74	0.0%	0.11	0.22	0.22	0.19
EQUIPMENT AND MATERIALS	2755	5338	8093	5.15%	3.44	6.67	10.12	66.0%	0.73	2.32	3.88	3.19
Pipes & Fittings	958	1702	2660	1.69%	1.20	2.13	3.33	64.0%	0.67	1.16	1.00	0.50
Pumps and Motors	140	326	466	0.30%	0.17	0.41	0.58	70.0%	0.00	0.17	0.29	0.12
Electrical & Substation	297	693	990	0.63%	0.37	0.87	1.24	70.0%	0.00	0.19	0.50	0.56
Controls	334	1891	2225	1.41%	0.42	2.36	2.78	85.0%	0.00	0.14	1.25	1.39
Other equipment	484	725	1209	0.77%	0.60	0.91	1.51	60.0%	0.00	0.45	0.60	0.45
Taxes and Duties	543	0	543	0.35%	0.68	0.00	0.68	0.0%	0.07	0.20	0.24	0.17
5] LAND ACQUIS. & COMPENSATION.	7900	0	7900	5.02%	9.88	0.00	9.88	0.0%	4.94	3.95	0.99	0.00
6] ENGINEERING & TECH.ASSIST.	3604	976	4580	2.91%	4.51	1.22	5.73	21.31%	1.65	1.65	1.22	1.22
Project Administration	1300	0	1300	0.83%	1.63	0.00	1.63	0.0%	0.41	0.41	0.41	0.41
Project Supervision	2268	972	3240	2.06%	2.84	1.22	4.05	30.0%	1.22	1.22	0.81	0.81
Bulk Water Tariff Study	36	4	40	0.03%	0.05	0.01	0.05	10.0%	0.03	0.03	0.00	0.00
BASIC COST, PRICES OF 1/ 1985	94854	62427	157281	100.00%	118.57	78.03	196.60	39.7%	32.80	60.23	62.77	40.70
PHYSICAL CONTINGENCIES 1]	9485	6243	15728	10.00%	11.86	7.80	19.66	39.7%	3.29	6.02	6.28	4.07
TOTAL CONSTANT PRICES 1]	104339	68670	173009	110.00%	130.42	85.84	216.26	39.7%	36.19	66.25	69.05	44.77
PRICE CONTINGENCIES 1]	8887	9308	18196	11.57%	18.48	17.38	35.84	51.2%	0.76	6.83	14.16	14.09
TOTAL PROJECT COST 1]	113227	77978	191205	121.57%	148.88	103.22	252.10	40.8%	36.95	73.09	83.21	58.86
FRONT-END FEE ON BANK LOAN		190	190	0.12%		0.24	0.24	100.0%	0.24	0.00	0.00	0.00
TOTAL FINANCING REQUIRED 1]	113227	78168	191394	121.88%	148.88	103.45	252.34	40.8%	37.18	73.09	83.21	58.86

1] Due to rounding the last digit in totals may appear different than the sum of digits

07-Jan-85

ANNEX 6

KOREA - METROPOLITAN REGION WATER SUPPLY PROJECT

DISBURSEMENT SCHEDULE

(US$ Million)

Bank's fiscal year	Year and Semester ending	Disbursement	Cumulative Disbursement	DISBURSEMENT PROFILE Korea	Project
1985	06/30/1985	0.2	0.2	0.7%	0.2%
1986	12/31/1985	5.3	5.5	5.2%	5.8%
	06/30/1986	5.4	10.9	13.6%	11.5%
1987	12/31/1986	12.0	22.9	25.7%	24.1%
	06/30/1987	13.0	35.9	40.2%	37.8%
1988	12/31/1987	16.0	51.9	54.6%	54.6%
	06/30/1988	17.0	68.9	68.1%	72.5%
1989	12/31/1988	13.0	81.9	78.9%	86.2%
	06/30/1989	12.0	93.9	87.1%	98.8%
1990	12/31/1989	1.1	95.0	94.0%	100.0%

01-Jan-80

KOREA - METROPOLITAN REGION WATER SUPPLY PROJECT

COMPLEMENTARY WATER WORKS REQUIRED BY THE MUNICIPALITIES 1]

CITIES AND TOWNS	POPULATION CONNECTED (THOUSAND)		INCREMENTAL POPULATION (THOUSAND)	WATER ALLOCATION	WATER WORKS REQUIRED				PROJECT COST
	1983	1988		1000 mtpd	TREATMENT PLANT 1000 mtpd	TRANS-MISION Kms	DISTRI-BUTION Kms	RESERVOIR 1000 mt	MILLION WON
Incheon	1135	1359	224	300			90.0	75	36550
Bucheon	275	401	126	150		4.5	68.0	25	10980
Kwangmyeong	109	182	73	90		4.5	1.0	72	5110
Anyang	238	316	78	80	80	4	10.0		7000
Eiuwmag/Gunpo	36	101	65	15		5	7.0	1.5	2800
Sorae	0	26	26	10		3		1.5	600
Seongnam	367	399	32	50			43.0	15	6610
Suweon	303	387	84	80		8	21.0	10	7410
Songtan	53	66	13	10		1.2	13.0	2.5	1980
Yongin/Giheum	12	32	20	25			85.0	8	1800
Osan, Dongtan, Taan, Jinwee	32	67	35	20			5.0	2	470
Dongbu	0	32	32	20	20	2.8	20.0	2.7	4970
Guri,Migeum, Wabu,Byolnae, Jingeon	54	148	94	40			46.0	5	8720
Total for 22 Municipalities	2614	3516	902	890	100	33	409	220.2	95200
Gimpo	6	21	15	10	5.5	11	12	1	2100
Euijumboo	102	139	37	60		5	19	10	4480
Incheon, Bucheon, Kwangmyeon					550				26000
Investment being financed by ADB	108	160	52	70	555.5	16	31	11	32580
TOTAL COMPLEMENTARY WORKS	2722	3676	954	960	655.5	49	440		127780

1] Include works to provide water services to existing population and to expand treatment and distribution capacities for the proposed project.

21-Aug-84

ISWACO - WATER DIVISION.

ANNEX 8
TABLE 1

INCOME STATEMENT 1] Million Won

FY ends 12/31

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Raw Water Sold - Million mt	919	1010	1120	1149	1204	1211	1221	1423	1518	1629
Treated Water Sold - Million mt	28	35	56	51	54	57	60	237	297	365
Total Water Sold - Million mt	947	1045	1176	1200	1258	1268	1281	1660	1816	1994
% Unnaccounted-for Water	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Water Production - Million mt	997	1100	1238	1263	1324	1335	1348	1747	1912	2099
Raw Water Tariff W per mt	32.66	31.95	32.00	35.20	37.31	39.17	44.10	42.54	44.63	44.70
Treated Water Tariff W per mt	74.54	76.43	74.40	81.84	86.74	91.06	102.52	98.90	103.75	103.94
Total Average Tariff per mt	33.89	33.44	34.02	37.18	39.43	41.50	46.83	50.58	54.30	55.55
Raw Water Revenues	30011	32270	35830	40445	44920	47430	53841	60531	67786	72822
Treated Water Revenues	2087	2675	4166	4174	4884	5191	6151	23439	30815	37937
Other Revenues	0	0	0	0	0	0	0	0	0	0
TOTAL OPERATING REVENUES	32098	34945	39997	44619	49804	52621	59992	83970	98601	110759
Personnel	2675	3336	3564	3799	4011	4285	4978	5918	6521	7172
Power	13937	14743	16020	16807	18333	19497	20786	28482	32901	38237
Materials & Chemicals	337	377	399	438	455	490	527	612	677	738
Maintenance	556	894	934	917	954	1027	1105	1258	1354	1461
Raw Water	1363	2063	4219	4568	4980	5298	5644	7716	8808	10341
Other Cost	672	897	887	889	1049	1129	1215	1384	1490	1607
Administration	839	1464	1407	1600	1689	1808	2003	2434	2683	2951
Other costs	0	0	0	0	0	0	0	0	0	0
Taxes	568	1137	1523	2159	2810	3155	3320	6298	8374	11380
TOTAL OPERATING EXPENSES	20947	24911	28953	31277	34281	36895	39578	54103	62907	73887
INCOME BEFORE DEPRECIATION	11151	10033	11043	13341	15523	15925	20414	29868	35694	36881
Depreciation	4269	4471	5545	5729	5981	6331	8100	11707	14077	14817
OPERATING INCOME	6882	5562	5498	7613	9542	9595	12314	18160	21618	22045
Non-cash Expenses (deferred)	0	0	89	253	253	253	253			
Operational Interest	1144	1198	1363	1270	1174	1062	1481	7040	6752	6028
Other Income (net)	680	1189	1254	810	850	910	960	1020	1080	1080
NET INCOME	6418	5553	5290	6900	8765	9190	11580	12140	15945	17099
RATIOS AND COMPARATORS:										
Cost per m3 of water sold	22.12	23.84	24.63	26.06	27.25	28.84	30.90	32.59	34.64	37.08
Working Ratio	65.3%	71.3%	72.4%	70.1%	69.1%	69.7%	66.0%	64.4%	63.8%	66.7%
Operating Ratio	78.6%	84.1%	86.5%	83.5%	81.7%	82.2%	79.9%	78.4%	78.1%	80.1%
Net Income on Revenues	20.0%	15.9%	13.2%	15.5%	17.7%	17.5%	19.3%	14.5%	16.2%	15.4%
Increases in Tariffs		-1.3%	1.7%	9.3%	6.0%	5.2%	12.9%	8.0%	7.3%	2.3%
Increase in Operating Revenues		8.8%	14.5%	11.6%	11.2%	6.1%	14.0%	40.0%	17.4%	12.3%
Increase in Water Sold		10.3%	12.5%	2.1%	4.8%	0.8%	1.0%	29.8%	8.4%	9.5%
Average Asset's Rate Base	160652	170371	182186	184387	186837	191897	246280	363202	432354	440861
Rate of Return on Revalued Asset	4.3%	3.3%	3.0%	4.1%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%

1] Due to rounding, the last digit in totals may appear different than the sum of columns.
07-Jan-85

ANNEX 8
TABLE 2

I S W A C O - W A T E R D I V I S I O N.

SOURCES AND APPLICATIONS OF FUNDS

Million Won

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
SOURCES OF FUNDS:										
Income before depreciation	11151	10033	11043	13341	15323	15825	20414	29888	35894	36861
Other income	680	1189	1254	810	850	910	960	1020	1080	1080
User's Contributions	0	0	0	0	0	0	0	0	0	0
GROSS INTERNAL CASH GENERATION	11831	11222	12297	14151	16173	16835	21374	30888	36774	37941
Operational Grants										
Equity Contributions	0	0	0	20000	44689	43782	25539	0	0	0
BORROWING										
Proposed IBRD loan	0	0	0	4400	13473	21733	21762	9326	0	0
Other	0	0	0	0	0	0	0	0	0	0
Other Loans	550									
TOTAL BORROWING	550	0	0	4400	13473	21733	21762	9326	0	0
TOTAL SOURCES OF FUNDS	12381	11222	12297	38551	74315	82350	68675	40213	36774	37941
APPLICATIONS OF FUNDS:										
Metropolitan Project				29744	58584	62358	42897	0		
Interest Capitalized	0	0	0	653	1548	3157	4804	0	0	0
Replacements	50	406								
Other Water Works			1858	3970	400	200	10000	15000	15000	15000
Invest.becoming deferred expense	190									
TOTAL CAPITAL EXPENDITURES	240	406	1858	34367	58542	65715	57301	15000	15000	15000
Amortization	1000	1040	1196	1287	1385	1493	2198	7822	7756	7898
Operational Interest	1144	1198	1363	1270	1174	1062	1461	7040	6752	6026
TOTAL DEBT SERVICE	2144	2238	2558	2557	2559	2555	3658	14862	14508	13924
WORKING CAPITAL NEEDS 1]	1040	-319	1205	20288	15142	15182	437	2188	1243	1216
OTHER ASSETS/LIABIL. CHANGES	-430	316	-934	-340	-370	-390	-460	-550	-690	0
TOTAL APPLICATIONS OF FUNDS	2994	2641	4688	56882	75873	83061	60837	31300	30082	30140
CASH INCREASE (+) OR DECREASE	9387	8581	7609	-18331	-1558	-711	7738	8914	6713	7802
Debt Service Ratio	5.5	5.0	4.8	5.5	6.3	6.6	5.8	2.1	2.5	2.7
% Contribution to Investment	3782.1%	2213.7%	509.8%	-24.3%	-2.0%	-0.8%	31.0%	97.3%	144.8%	152.0%
% Capital expend. of Net Assets	0.1%	0.2%	1.0%	19.5%	30.8%	33.8%	19.2%	3.5%	3.4%	3.4%

1] Includes loans or cash transfers for the Dams Division

07-Jan-85

ANNEX 8
TABLE 3

ISWACO - WATER DIVISION.

BALANCE STATEMENT

Million Won

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Fixed Assets in Operation	170328	194648	201440	207742	219500	232679	345894	490351	515117	543234
Accumulated Depreciation	9676	14558	17157	23250	30318	38066	47946	61885	78885	97704
NET FIXED ASSETS	160652	180090	184283	184492	189182	194612	297948	428458	436252	445530
WORK IN PROGRESS	256	574	1282	33649	90191	153055	110358	0	13200	28400
Cash	16028	24609	32219	13888	12330	11618	19357	28270	34983	42785
Accounts Receivable	3101	3378	4000	4438	4980	5282	5999	8397	9880	11076
Inventories	248	188	560	590	630	660	720	810	950	950
Other Current Assets	5	2	70	80	90	100	110	120	140	140
Loans to Dams Division	0			20000	35000	50000	50000	50000	50000	50000
TOTAL CURRENT ASSETS	19380	28177	36849	38996	53010	67841	76186	87598	95933	104851
DEFERRED EXPENSES	867	1151	1052	789	546	293	40	40	40	40
OTHER ASSETS	28	28	28	28	28	28	28	28	28	28
TOTAL ASSETS	181181	210020	223494	257964	332957	415629	484558	516122	545453	578949
Accounts Payable	1288	1823	1880	1860	2290	2450	2820	3130	3510	3510
Other Current Liabilities	0	0	0	0	0	0	0	0	0	0
Current Matur.Long-Term Debt	1040	1196	1287	1385	1493	2198	7622	7758	7898	7898
TOTAL CURRENT LIABILITIES	2328	3019	2967	3245	3783	4648	10442	10888	11408	11408
Other Liabilities	3160	2846	3780	4120	4490	4880	5340	5890	6580	6580
Long-Term Debt [net]	14099	13177	15250	18265	30245	49779	63819	65489	57591	49893
TOTAL LIABILITIES	19577	19042	21997	25630	38518	59307	79701	82285	75579	67881
Assets Revaluation Surplus	20955	28106	35780	38665	46087	53467	63042	77588	94759	113481
Operational Surplus [+]	7033	12586	17877	24777	33541	42731	54292	66432	82377	99476
Capital	133616	150286	147840	168893	214811	260124	287524	289837	292739	298331
TOTAL EQUITY	161604	190978	201497	232334	294438	356322	404857	433857	469875	509288
TOTAL EQUITY AND LIABILITIES	181181	210020	223494	257964	332957	415629	484558	516122	545453	578949
Current Ratio	8.3	9.3	12.4	12.0	14.0	14.6	7.3	8.0	8.4	9.2
Working Capital, exclud. cash	2064	1745	2950	23248	38390	53572	54009	56197	57440	58856
% Debt on Debt plus Equity	8.8%	7.0%	7.6%	7.8%	9.7%	12.7%	15.0%	14.4%	12.2%	10.2%
# Days Accounts Receivable	35	35	37	36	37	37	37	37	37	37
% Debt/[Net Fixed Assets +WIP]	9%	8%	9%	9%	11%	15%	18%	17%	15%	12%

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ANNEX 8
TABLE 4

I S W A C O - W A T E R D I V I S I O N.

FINANCING PLAN

Million Won

	TOTAL	% OF TOTAL	1985	1986	1987	1988	1989
Income Before Depreciation	94872	41.1%	13341	15323	15925	20414	29868
Other Income	4550	2.0%	810	850	910	980	1020
User's Contributions	0	0.0%	0	0	0	0	0
GROSS INTERNAL CASH GENERATION	99422	43.1%	14151	16173	16835	21374	30888
MINUS:							
Amortization	13985	6.1%	1287	1385	1493	2198	7622
Operational Interest	12008	5.2%	1270	1174	1062	1461	7040
TOTAL DEBT SERVICE	25992	11.3%	2557	2559	2555	3659	14662
WORKING CAPITAL NEEDS (+)	53247	23.1%	20288	15142	15182	437	2188
OTHER ASSETS (+) OR LIAB.NEEDS	-2110	-0.9%	-340	-370	-390	-480	-550
CASH INCREASE (+) OR DECREASE	-3948	-1.7%	-18331	-1558	-711	7738	8914
NET INTERNAL CASH GENERATION	26241	11.4%	9967	400	200	10000	5674
CAPITAL EXPENDITURES							
Metropolitan Project	191382	82.9%	28744	56594	62358	42687	0
Interest Capitalized	9962	4.3%	653	1548	3157	4604	0
Replacements	0	0.0%	0	0	0	0	0
Other Works	29570	12.8%	3970	400	200	10000	15000
Invest.becoming deferred expense	0	0.0%	0	0	0	0	0
TOTAL CAPITAL EXPENDITURES	230924	100.0%	34367	58542	65715	57301	15000
NET TO BE FINANCED:	204683	88.6%	24400	58142	65515	47301	9326
FINANCED BY:							
Proposed IBRD loan	70693	30.6%	4400	13473	21733	21762	9326
Government loans	0	0.0%	0	0	0	0	0
Other loans	0	0.0%	0	0	0	0	0
TOTAL BORROWING	70693	30.6%	4400	13473	21733	21762	9326
Operational Grants	0		0	0	0	0	0
Equity Contributions	133990	58.0%	20000	44669	43782	25539	0
TOTAL FINANCED	204683	88.6%	24400	58142	65515	47301	9326

07-Jan-85

ANNEX 8
TABLE 5

ISWACO - WATER DIVISION.

MONITORING INDICATORS

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
DEMAND										
Raw Water Sold - Million mt	819	1010	1120	1149	1204	1211	1221	1423	1519	1629
Treated Water Sold - Million mt	28	35	56	51	54	57	60	237	297	365
Total Water Sold -Million mt	847	1045	1176	1200	1258	1268	1281	1660	1816	1994
Water Production - Million mt	997	1100	1238	1263	1324	1335	1348	1747	1912	2099
MANAGEMENT:										
# Days Accounts Receivable	35	35	37	36	37	37	37	37	37	37
Number of Employees	520	565	600	600	600	600	640	700	710	710
% Increase # of employees		8.7%	6.2%	0.0%	0.0%	0.0%	6.7%	9.4%	1.4%	0.0%
% Personnel Cost on Total	13%	13%	12%	12%	12%	12%	13%	11%	10%	10%
FINANCIAL										
Raw Water Tariff W/mt	32.66	31.85	32.00	35.20	37.31	39.17	44.18	42.54	44.83	44.70
Treated Water Tariff W/mt	74.54	76.43	74.40	81.84	86.74	91.06	102.52	98.90	103.75	103.94
Total Average Tariff W/mt	33.9	33.4	34.0	37.2	39.4	41.5	46.8	50.8	54.3	56.5
Increase Total Average Tariff		-1.3%	1.7%	9.3%	6.0%	5.2%	12.8%	8.0%	7.3%	2.3%
Working Ratio	65.3%	71.3%	72.4%	70.1%	69.1%	69.7%	66.0%	64.4%	63.8%	66.7%
Contribution to investment	3782.1%	2213.7%	508.8%	-24.3%	-2.0%	-0.8%	31.0%	97.3%	144.8%	152.0%
Rate of Return	4.3%	3.3%	3.0%	4.1%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Debt Service ratio	5.5	5.0	4.8	5.5	6.3	6.8	5.8	2.1	2.5	2.7
Debt on Debt plus Equity	9%	7%	8%	8%	10%	13%	15%	14%	12%	10%
1984 CONSTANT PRICE ANALYSIS:										
Raw Water tariff (W/mt)	36.11	33.29	32.00	34.19	34.85	34.87	37.00	33.83	33.64	31.87
Treated Water Tariffs (W/mt)	82.42	79.64	74.40	79.49	81.02	80.62	86.03	78.66	78.22	74.10
Salary 000/employee/year	429	482	505	513	520	528	544	560	577	600
Operational Expend./mt Sold	22.1	23.8	24.6	26.1	27.3	28.9	30.9	32.6	34.6	37.1

CRITICAL FINANCIAL INDICATORS FOR THE PERIOD 1985-1991:

VARIABLE OR INDICATOR	MINIMUM	AVERAGE	MAXIMUM	VARIABLE OR INDICATOR	MINIMUM	AVERAGE	MAXIMUM
Cash	11619	23319	42785	Debt Service Ratio	2.1	4.5	6.8
Raw Water Tariff, constant price	31.9	34.3	37.0	Treated Water Tariff,c.prices	74.1	79.7	86.0
Working Ratio	63.8%	67.1%	70.1%	Days Accounts Receivable	36	36	37
Rate of Return	4.1%	4.9%	5.0%	Debt/(debt + equity)	7.8%	11.7%	15.0%

07-Jan-85

ANNEX 9
TABLE 1

I S W A C O - D A M S D I V I S I O N.

INCOME STATEMENT 1]

Million Won
Fy ends 12/31

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
SALES OF SERVICES:										
Mun.& Ind.Water Rights Mill.Tons	1004	1048	1281	1294	1408	1539	2158	2383	2671	2956
Power sales, GWH	614	681	837	1085	1518	1516	1747	1745	1743	1741
Irrigated Land, ha	140	191	633	5200	6300	7400	8500	9600	10700	11000
AVERAGE RATES:										
Mun.& Ind. Water Rights W/mt	1.81	2.68	3.70	4.73	5.41	6.41	6.88	8.02	8.84	9.68
Power, W/KWH	13.82	20.72	23.70	26.78	31.30	37.21	38.93	45.05	49.45	53.95
Irrigated Land, W Million/ha	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03
REVENUES (Million Won)										
Municipal & Ind. Water	1918	2810	4737	6120	7827	9866	14847	19194	23617	28626
Power sales	8484	14318	15098	29320	47971	56405	68018	78611	86196	93929
Irrigated Land Rights	3	4	13	112	147	199	227	291	348	383
Other Revenues	0	0	0	0	0	0	0	0	0	0
TOTAL OPERATING REVENUES	10405	17132	19848	35552	55745	66470	83092	98086	110162	122937
Personnel	2254	2531	2509	3430	3802	3838	4242	5253	5598	6118
Power	498	483	400	423	456	503	551	582	644	715
Maintenance	348	380	340	386	437	481	545	575	667	776
Other expenses	0	0	0	0	0	0	0	0	0	0
Other direct expenses	640	811	620	672	723	788	843	890	1032	1201
Administration	1029	1081	1110	1209	1320	1393	1592	1679	1908	2173
Taxes	238	524	350	503	1124	991	2184	2257	3428	4724
TOTAL OPERATING EXPENSES	5005	5770	5329	6802	7862	7954	9958	11236	13278	15708
INCOME BEFORE DEPRECIATION	5400	11362	14519	28949	48084	58516	73134	86859	96888	107230
Depreciation	5558	7732	8026	12086	17886	21941	27568	33001	37252	41732
OPERATING INCOME	-158	3630	6493	16864	30198	36575	45567	53858	59634	65497
Non-cash Expenses (deferred)	0	91	150	200	250	0	0	0	0	0
Operational Interest	2513	2536	2392	2168	12122	11250	24684	26889	24923	21809
Other Income (net)	0	776	729	700	700	700	700	700	700	700
NET INCOME	-2669	1779	4680	15196	18526	26025	21583	27669	35412	44388
RATIOS AND COMPARATORS:										
Working Ratio	48.1%	33.7%	26.8%	18.6%	13.7%	12.0%	12.0%	11.5%	12.1%	12.8%
Operating Ratio	101.5%	79.3%	68.0%	53.1%	46.3%	45.0%	45.2%	45.1%	45.9%	46.7%
Net Income on Revenues	-25.7%	10.4%	23.6%	42.7%	33.2%	39.2%	26.0%	28.2%	32.1%	36.1%
Increase in Operating Revenues		64.7%	15.9%	79.1%	56.8%	19.2%	25.0%	18.1%	12.3%	11.6%
Increase in Power Sold		12.6%	-7.8%	71.9%	38.8%	-0.1%	15.2%	-0.1%	-0.1%	-0.1%
Average Asset's Rate Base	167082	218389	288032	405613	603854	731499	911334	1077160	1192682	1308950
Rate of Return on Revalued Asset	-0.1%	1.7%	2.4%	4.2%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%

1] Due to rounding, the last digit in totals may appear different than the sum of columns.
07-Jan-85

ANNEX 9
TABLE 2

I S W A C O - D A M S D I V I S I O N.

SOURCES AND APPLICATIONS OF FUNDS — Million Won

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
SOURCES OF FUNDS:										
Income before depreciation	5400	11382	14519	28949	48084	58518	73134	86859	96866	107230
Other income	0	776	729	700	700	700	700	700	700	700
Land reclamation, [Nagdong]	0	0	0	0	0	19640	28057	32682	4000	0
GROSS INTERNAL CASH GENERATION	5400	12138	15248	29649	48784	78856	101891	120241	101586	107930
Chungju	87472	99570	70000	41793						
Nakdong			15000	27737	10000					
Hapcheon		8112	11000	14734	9898	4500				
Juam and Others		11454	28439	47000	43412	37670	34793	23896		
Total Equity Contributions	87472	119136	124439	131284	83108	42170	34793	23896	0	0
BORROWING										
IBRD [2350 KO] - Nagdong	0	0	12301	18738	18560	4636		0	0	0
IBRD [1668 KO] - Chungju Dam	15355	19807	11606	640				0	0	0
OECF - Chungju	12576	5888	7305	12484						
OECF - Hapcheon	0	4301	9761	22022	28116	4843		0	0	0
OECF - Juam			4190	9637	10601	10001	2898	989	62	
Oil Fund		33900								
Other Loans									10000	14000
KDB Loans [Hapcheon]	0	0	85410	25535	26292	8930				
TOTAL BORROWING	27931	63896	130573	89036	83569	28410	2898	989	10062	14000
TOTAL SOURCES OF FUNDS	130803	195170	270280	249948	195461	149436	139583	144826	111648	121930
APPLICATIONS OF FUNDS:										
Nagdong Barrage		6771	32423	57373	41330	22542				
Interest Capitalized	4185	7171	13721	24484	20284	24229	8872	5497	2598	1690
Chungju Dam	84298	158818	148911	54897						
Hapcheon Dam	3133	265	58132	82291	55822	17580				
Other and Juam Dam	72	270	32830	46445	54013	47671	37892	38000	35000	35000
Invest.to become defer.expenses	190									
TOTAL CAPITAL EXPENDITURES	91878	173095	285917	245490	171449	112002	48564	43497	37598	36690
Amortization	4152	8369	10278	15843	15879	32798	45588	54507	58297	62241
Operational Interest	2513	2536	2392	2188	12122	11250	24884	26889	24923	21809
TOTAL DEBT SERVICE	6665	10905	12670	17811	27801	44049	70252	81396	83219	84050
WORKING CAPITAL NEEDS [+]	-1000	-1854	-8037	5098	4964	5321	563	1631	18	1166
OTHER ASSETS/LIABIL. CHANGES	0	0	0	-20000	-15000	-15000	0	0	0	0
TOTAL APPLICATIONS OF FUNDS	97541	182148	290450	248397	189214	146372	117378	126524	120837	121906
CASH INCREASE [+] OR DECREASE	33262	13024	-20190	1552	6247	3064	22205	18402	-9189	24
Debt Service Ratio	0.8	1.1	1.2	1.7	1.8	1.8	1.5	1.5	1.2	1.3
% Contribution to Investment	-0.3%	1.8%	3.7%	10.8%	18.1%	39.7%	68.7%	85.6%	48.8%	61.9%
% Capital expend. of Net Assets	55.0%	64.2%	109.0%	44.7%	26.0%	13.9%	4.6%	3.8%	3.0%	2.7%

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ANNEX 9
TABLE 3

I S W A C O - D A M S D I V I S I O N.

BALANCE STATEMENT Million Won

Fy ends 12/31

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Fixed Assets in Operation	187140	296802	297908	597318	727580	887703	1144346	1300181	1459209	1632077
Accumulated Depreciation	20078	26867	35578	48420	68569	93716	125685	164541	209485	261901
NET FIXED ASSETS	167062	269735	262328	548898	658011	803987	1018661	1135640	1249724	1370175
WORK IN PROGRESS	168975	334891	620415	517905	539354	491756	298320	221817	144215	65705
Cash	10184	23188	2998	4550	10797	13861	38068	54468	45279	45303
Accounts Receivable	900	5490	1920	2793	4460	5318	6647	7848	8813	9835
Inventories	1308	996	1052	1126	1372	1454	1696	1798	1906	2000
Other Current Assets	784	1884	538	575	610	646	685	726	770	820
TOTAL CURRENT ASSETS	13167	31588	6508	9044	17238	21279	45095	64840	56768	57958
DEFERRED EXPENSES	11717	9105	8955	8755	8505	8505	8505	8505	8505	8505
OTHER FIXED ASSETS[NOT FOR ROR]	0	0	0	58000	108000	134600	174800	194800	213800	233000
OTHER ASSETS										
TOTAL ASSETS	360921	645299	898206	1084602	1224109	1325527	1370801	1430803	1459213	1502344
Accounts Payable	1443	1831	858	1013	1382	1492	1837	2004	2349	2349
Contractor's Payable	5848	12691	16833	12564	9179	4724	5427	4972	5725	5725
Current Matur.Long-Term Debt	8144	10278	15643	15679	32799	45588	54507	58297	62241	0
TOTAL CURRENT LIABILITIES	15435	24800	33332	29256	43360	51784	61771	65273	70315	8074
Loan from the Water Division				20000	35000	50000	50000	50000	50000	50000
Long-Term Debt (net)	122961	187542	302472	375829	426598	409441	357833	300525	248347	262347
TOTAL LIABILITIES	138396	212342	335804	425085	504958	511225	469604	415798	368661	320421
Assets Revaluation Surplus	25862	141331	137755	142368	185788	194218	229861	271820	317548	372237
Operational Surplus (+)	-3866	-2187	2483	17689	38214	62239	83822	111491	146903	191291
Capital	200828	293813	422154	499461	517147	557844	587313	631693	626100	618395
TOTAL EQUITY	222525	432957	562402	658517	719150	814302	900997	1015004	1090551	1181923
TOTAL EQUITY AND LIABILITIES	360921	645299	898206	1084602	1224109	1325527	1370601	1430803	1459213	1502344
Current Ratio	0.9	1.3	0.2	0.3	0.4	0.4	0.7	1.0	0.8	7.2
Working Capital, exclud. cash	-4288	-6142	-14179	-9083	-4119	1202	1764	3396	3415	4581
% Debt on Debt plus Equity	37.1%	31.4%	36.1%	37.3%	39.0%	35.8%	31.4%	26.1%	22.2%	18.2%
# Days Accounts Receivable	32	117	35	29	29	29	29	29	29	29
% Debt/[Net Fixed Assets +WIP]	39%	33%	36%	37%	38%	35%	31%	26%	22%	18%

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ANNEX 9
TABLE 4

I S W A C O - D A M S D I V I S I O N.

FINANCING PLAN

Million Won

	TOTAL	% OF TOTAL	1984	1985	1986	1987	1988
Income Before Depreciation	223203	25.9%	14519	28949	48084	58516	73134
Other Income	3529	0.4%	729	700	700	700	700
User's Contributions	47697	5.5%	0	0	0	19640	28057
GROSS INTERNAL CASH GENERATION	274429	31.9%	15248	29649	48784	78856	101891
MINUS:							
Amortization	119867	13.9%	10278	15643	15879	32798	45588
Operational Interest	52816	6.1%	2392	2188	12122	11250	24684
TOTAL DEBT SERVICE	172683	20.0%	12670	17811	27801	44048	70252
WORKING CAPITAL NEEDS (+)	7908	0.9%	-8037	5098	4984	5321	583
OTHER ASSETS (+) OR LIAB.NEEDS	-50000	-5.8%	0	-20000	-15000	-15000	0
CASH INCREASE (+) OR DECREASE	12878	1.5%	-20190	1552	8247	3084	22205
NET INTERNAL CASH GENERATION	131061	15.2%	30805	25190	24772	41422	8872
CAPITAL EXPENDITURES							
Nagdong Barrage	153868	17.8%	32423	57373	41330	22542	0
Interest Capitalized	91590	10.6%	13721	24484	20284	24229	8872
Chungju Dam	203808	23.7%	148911	54897	0	0	0
Hapcheon Dam	193805	22.5%	58132	62291	55822	17560	0
Other capital expenditures	218451	25.4%	32630	46445	54013	47871	37692
Invest.to become defer.expenses	0	0.0%	0	0	0	0	0
TOTAL CAPITAL EXPENDITURES	861322	100.0%	285817	245490	171446	112002	46564
NET TO BE FINANCED:	730261	84.8%	255012	220300	146677	70580	37692
FINANCED BY:							
IBRD (2350 KO) - Nagdong	52235	6.1%	12301	18738	16560	4636	0
IBRD (1668 KO) - Chungju Dam	12248	1.4%	11606	640	0	0	0
OECF - Chungju	19789	2.3%	7305	12484	0	0	0
OECF - Hapcheon	64742	7.5%	9781	22022	28116	4843	0
OECF - Juam	37328	4.3%	4190	9637	10601	10001	2899
Oil Fund	0	0.0%	0	0	0	0	0
Other Loans	0	0.0%	0	0	C	0	0
KDB Loans (Hapcheon)	148167	17.2%	85410	25535	28282	8830	0
TOTAL BORROWING	334487	38.8%	130573	88036	83559	28410	2899
Equity Contributions	395774	45.9%	124439	131264	63108	42170	34793
TOTAL FINANCED	730261	84.8%	255012	220300	146677	70580	37692

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ANNEX 9
TABLE 5

ISWACO - DAMS DIVISION.

MONITORING INDICATORS

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
DEMAND										
Mun.& Ind. Water Rights-Mill.mt	1004	1048	1281	1294	1408	1539	2158	2393	2671	2958
Power sales - GWH	614	691	837	1095	1518	1518	1747	1745	1743	1741
Irrigated Land, ha	140	191	633	5200	6300	7400	8500	9600	10700	11000
MANAGEMENT:										
# Days Accounts Receivable	32	117	35	29	29	29	29	29	29	29
Number of Employees	389	387	395	535	535	535	555	645	645	660
% Increase # of employees		99.5%	102.1%	135.4%	100.0%	100.0%	103.7%	116.2%	100.0%	102.3%
FINANCIAL										
Average Rates:										
Mun.& Ind. Water Rights W/mt	1.91	2.68	3.70	4.73	5.41	6.41	6.88	8.02	8.84	9.88
Power, W/KWH	13.82	20.72	23.70	26.78	31.80	37.21	38.93	45.05	49.45	53.95
Irrigated Land, W/ha	20880	20880	20880	21454	23337	26932	28692	30273	32575	34834
Working Ratio	48.1%	33.7%	26.8%	18.8%	13.7%	12.0%	12.0%	11.5%	12.1%	12.8%
Contribution to investment	-0.3%	1.8%	3.7%	10.9%	18.1%	39.7%	66.7%	85.6%	48.8%	61.9%
Rate of Return	-0.1%	1.7%	2.4%	4.2%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Debt Service ratio	0.6	1.1	1.2	1.7	1.8	1.8	1.5	1.5	1.2	1.3
Debt on Debt plus Equity	37%	31%	36%	37%	38%	36%	31%	26%	22%	18%
1984 CONSTANT PRICE ANALYSIS:										
Total Revenues- Million W	11321	17889	19848	34600	52167	58960	69862	78177	83218	87817
Real Increase in Revenues		58.3%	12.2%	74.3%	50.8%	13.0%	18.5%	11.9%	6.4%	5.5%
Mun.& Ind. Water Rights W/mt	2.08	2.77	3.70	4.80	5.07	5.69	5.78	6.39	6.68	6.92
Power, W/KWH	15.04	21.38	23.70	28.06	29.57	33.00	32.74	35.90	37.36	38.54
Irrigated Land, W/ha	22717	21559	20880	20880	21838	23889	22442	24126	24607	24883
Salary 000/employee/year	483	545	529	520	525	530	536	541	546	552

CRITICAL FINANCIAL INDICATORS BETWEEN 1985-1991

VARIABLE OR INDICATOR	MINIMUM	AVERAGE	MAXIMUM	VARIABLE OR INDICATOR	MINIMUM	AVERAGE	MAXIMUM
Cash	4550	30047	54468	Debt Service Ratio	1.2	1.5	1.8
Power Tariff W/Kwh[const.prices]	28.06	33.31	38.54	Contribution to invest.	10.8%	47.4%	85.6%
Working ratio	11.5%	13.2%	18.8%	Days Accounts Receivable	29	29	29
Rate of Return	4.2%	4.8%	5.0%	Debt/[debt + equity]	18.2%	30.0%	39.0%

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ANNEX 10
Table 1

KOREA

METROPOLITAN REGION WATER SUPPLY PROJECT

ISWACO Consolidated Financial Statements
Income Statement
(Million won)

	1980	1981	1982	1983
Operating Revenue				
Water supply	12,232	19,423	32,099	34,945
Dams	6,912	15,189	11,030	18,120
Industrial sites, new cities	60,890	35,931	28,823	41,955
Others	24,530	5,008	1,132	1,967
Total Revenue	104,564	75,551	73,084	96,987
Operating Expenses /a				
Water supply	11,094	18,402	24,943	27,980
Dames	6,325	11,752	12,692	15,312
Industrial sites, new cities	60,771	35,947	28,823	41,955
Others	23,762	4,477	1,264	1,217
Total Expenses	101,952	70,578	67,722	86,464
Gross income	2,612	4,973	5,362	10,523
General administration	2,469	2,880	3,647	3,998
Operating income	143	2,093	1,715	6,525
Nonoperating Income (Expenses)				
Interest income	2,963	3,813	4,096	3,493
Amortization of exchange losses	(216)	(997)	(940)	(23)
Other Net	1,183	1,662	779	985
Subtotal	3,930	4,478	3,935	4,455
Income before income taxes	4,073	6,571	5,650	10,980
Income taxes	445	742	806	1,661
Net Income	3,628	5,829	4,844	9,319

/a Includes depreciation and operational interest.

Source: Audit Report.

ANNEX 10
Table 2

KOREA

METROPOLITAN REGION WATER SUPPLY PROJECT

ISWACO Consolidated Financial Statements
Flow of Funds
(Million won)

	1980	1981	1982	1983
Sources				
Net income before depreciation	10,956	19,490	19,701	27,478
Receipts from development projects	12,692	35,792	31,440	83,150
Increase in advance receipt - net	13,287	(6,946)	7,465	10,147
Local loans	9,107	5,650	-	38,502
Foreign loans	32,140	42,684	17,931	24,137
Equity contributions	3,213	29,936	60,799	104,172
Other - net	(447)	3,259	831	712
Total Sources	80,948	129,865	138,167	288,298
Applications				
Capital expenditures	64,946	85,540	92,495	206,361
Capitalized interest	18,086	20,576	16,692	11,287
Amortization of local loan	6,043	10,359	11,217	14,694
Amortization of foreign loan	15,525	7,116	9,204	15,603
Operating interest	1,794	3,851	3,627	3,646
Payment of severance indemnities	969	115	158	681
Increase (decrease) of working capital	(26,415)	2,308	4,774	36,026
Total Applications	80,948	129,865	138,167	288,298

Source: ISWACO

ANNEX 10
Table 3

KOREA

METROPOLITAN REGION WATER SUPPLY PROJECT

ISWACO Consolidated Financial Statements
Balance Statement
(Million won)

	1980	1981	1982	1983
Assets				
Fixed Assets				
Dam Division	77,187	191,447	184,835	297,906
Accumulated depreciation	(12,072)	(14,535)	(19,498)	(15,313)
Water Supply Division	63,286	148,074	148,219	164,969
Accumulated depreciation	(1,528)	(4,160)	(8,429)	(12,854)
Operating facilities - other division net	7,817	16,773	4,199	5,943
Net	134,690	337,599	309,326	440,651
Construction in progress	32,619	84,792	169,231	335,697
Subtotal	167,309	422,391	478,557	776,348
Deferred charges	16,378	17,732	19,372	12,809
Other assets	190,400	187,003	180,767	146,549
Current Assets				
Cash	5,056	17,212	8,617	33,578
Accounts receivable	5,489	5,982	9,269	10,610
Inventories	842	1,268	2,110	2,194
Cbcxvs	15,428	11,953	26,776	70,202
Subtotal	26,815	36,415	46,772	116,584
Total Assets	400,902	663,541	725,468	1,052,290
Long-Term Liabilities				
Local loans	66,288	56,628	45,411	69,210
Foreign loans	53,028	126,241	137,089	151,011
Employees' severance indemnities	5,025	6,476	8,651	10,420
Others	78,533	163,209	151,355	161,303
Subtotal	202,874	352,554	342,506	391,953
Current Liabilities				
Accounts payable	11,158	7,607	6,694	17,147
Short-term borrowing	6,100	10,849	12,800	-
Current maturities of long-term loans	16,268	23,889	20,598	28,613
Others	7,864	6,336	14,172	42,289
Subtotal	41,390	48,681	54,264	88,049
Total Liabilities	244,264	401,235	396,770	480,002
Equity				
Capital	120,383	219,383	280,182	398,645
Revaluation surplus	25,617	25,663	25,663	141,346
Other surplus	171	211	211	785
Retained earning	10,467	17,049	22,642	31,512
Total Equity	156,538	262,306	328,698	572,288
Total Liabilities and Equity	400,902	663,541	725,468	1,052,290

Sources: Audit Reporu.

KOREA

METROPOLITAN REGION WATER SUPPLY PROJECT

Economic Analysis

Least-Cost Solution

1. The selection of the least-cost solution was a major issue during project preparation, The proposed treated bulk water system finally selected, is less expensive and more efficient than the raw bulk water systems built previously, but the municipalities initially preferred to have raw bulk water supplies with their own independent treatment plants. This was because: (a) they were familiar with raw bulk water systems, and (b) of differentials between treated and raw water tariffs. ISWACO's nationwide tariff for treated water is more than twice its raw water tariff; while water treatment in the Metropolitan area, because of the good quality of the raw water, adds only about 30% to the cost of raw water. Tariff studies under the project (para. 1.07) would improve the tariff structure and avoid this problem in future projects. The alternative of a bulk raw water system with several independent treatment plants vs one large treatment plant with a bulk treated water system was compared. After taking into consideration the special needs of Seoul (para. 3) which will build a separate treated water system with the trunk main laid on reclaimed land beside the Han River, the project as now designed with three treatment plants, is the least-cost solution for the whole Metropolitan Region and for the project. It is at least 20% less expensive at discount rates between 5% and 15% than the alternative of a raw water system with about 20 individual treatment plants. Also because of the dispersed nature of the larger population concentrations, and the special needs of raw water for industry, the facilities to be built under the project could be easily integrated with any future proposals for a Metropolitan Water Authority, including Seoul.

2. Three treatment plants would be provided, instead of one, for the following reasons: (a) the Euijeongbu system is on the northern side of the Han River, and would require an expensive bridge to carry the treated water from Paldang accross the river -- an independent river intake and treatment plant with a treated water trunk main was therefore selected for this component; (b) the other two treatment plants each with a capacity of over 400,000 mtpd were located near Incheon and Seongnam with approximately 40 km raw water trunk main, because of raw water supply en route to large industries which do not require treated water. The route selected for the pipelines is also the least expensive, avoiding as much as possible crossing the more densely populated areas. The optimal location of the treatment plant for Incheon and the neighboring municipalities was selected by consultants under an ADB technical assistance grant. The overall project design and routing was reviewed by the Design Review Panel convened by MOC, and their comments have been incorporated in the final design.

3. The appraisal analysis indicated that a proposed 500,000 mtpd allocation to Seoul City at the feasibility stage would not be needed because of expansion to its existing Gueui Treatment Plant (from 830,000 mtpd to 1,130,000 mtpd completed in 1984) and the construction in stages of a new treatment plant (Aamsa) with a capacity of 1,000,000 mtpd, both drawing water directly from the Han River. Under these conditions Seoul would not need water from the project until after 1995. The approximately 40 km of raw water trunk main was therefore redesigned by lowering transmission capacity by 500,000 mtpd and a separate connection to Seoul eliminated. This is justifiable, since improvements in the river water quality and the Han River Development Project (Annex 2) now provide a more economic source and routing for Seoul's water supply.

Project Costs and Benefits

4. The operation of the facilities included in the project requires about 160 employees. The number of employees, and operational expenditures for each system (personnel, power, chemicals, materials and maintenance, and others) together with the main assumptions are presented in Table 1.

5. The main cost in the project is its capital expenditures. Given the large economies of scale and the physical constraints, the two water intakes and seven tunnels included in the project have to be designed for the year 2000 (12 years after project completion).[1/] Therefore, the Project includes substantial costs which do not produce benefits during this first stage. Half the cost of the tunnels and intake (16% of the project cost) are a minimum estimate of the cost reduction which would result at the time of construction of the next stage (1991-92). The project cost also includes an integrated system for telemetering and remote control for all three regional systems to be centered at Paldang. Since this system (W 6.3 billion in 1985 prices) would benefit not only this project but the first two regional systems as well, only half of these costs are relevant for the project. All other components have been included in the analysis and are sized for a design horizon of six years, which is satisfactory.

Rate of Return

6. The internal rate of return (IRR) for the project, based on existing tariffs for treated water (W 82 per ton) is estimated at 10% (Table 2). The capital and operating expenses of the two project treatment plants (for Euijeongbu and Seongnam systems), as well as the estimated cost for the Incheon plant (W 26,000 million), and the individual plants for Anyang, Dongbu and Banwéol (W 11,000 million) are also included. This allows the total demand to be analyzed as treated water. Sensitivity analysis shows that the IRR would be 9% if the investments and operating expenses were increased by 10% or the benefits were reduced by 10% or there was a two year delay in construction. The economic rate of return (Table 3) has been estimated adding to the bulk water costs the investment and operating costs required to provide

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1/ Minimum tunnel diameter for economical construction is between 2 and 3 m.

water to the individual households. The cost of distribution works for the incremental population are based on Annex 7, excluding the treatment plants (already included in the bulk water cost), and the improvements for existing consumers. The per capita investment in distribution works is about $55, which is reasonable. Operating expenses are based on data for Seoul, Incheon and Euijeongbu, but exclude the cost of chemicals, which is already included in the cost of the bulk treated water, and the purchase of bulk water from ISWACO. Future power expenses for the municipalities are expected to be lower than at present, since the hydraulic gradient in the project pipelines would allow service by gravity to most municipalities. Benefits are estimated based on the present tariffs for Incheon and Bucheon, the two main users of water under the project. Further details on the analysis are given in the footnotes to the Table 3. The economic rate of return is estimated at 14%. The provision of water services is expected to increase the value of real estate values of the additional households served by the project. The present value in each year as a minimum proxy for this benefit is W 400,000 for each of the new households served (4% increase in the value of property to the lowest income households). Including these benefits, the economic rate of return is estimated at 19%.

Marginal Cost

7. The marginal cost for the treated water is W89 per metric ton in 1985 prices, ($0.11 per metric ton) for a discount rate of 10%. Present bulk water tariffs for treated water are only 8% lower (W82 per metric ton), which is the marginal cost for a discount rate of 9% (Table 2). This indicates that tariffs are satisfactorily close to the optimal marginal cost pricing. Tariff studies under the Project (para. 1.07) would further review and propose improvements on these tariffs.

KOREA - METROPOLITAN REGION WATER SUPPLY PROJECT

ECONOMIC ANALYSIS - ANNUAL OPERATIONAL EXPENSES 1]

(Million Won - Prices of January 1985)

System	Year	Average Water Demand 1000 mtpd 2]	Number of Employees	Personnel Expenses 3]	Power Demand Charges 4]	Power used charges 4]	Chemicals 5]	Materials and Maintenance 6]	Others 7]	Total Expenses	Total Expenses per metric ton 8]
Paldang Intake 2]	1989	352	25	119	310	1272		175	64	1940	
	1992	762	30	142	443	2756		263	139	3743	
	1996	1135	35	166	532	4104		350	207	5359	
Seongnam System and Treatment Plant	1989	137	20	95	122	584	50	94	100	1045	31
	1992	279	25	119	183	1189	102	141	204	1937	28
	1996	404	30	142	247	1722	147	188	295	2741	26
Incheon System and Treatment Plant 9]	1989	168	30	142	97	333	61	204	123	960	28
	1992	310	40	190	145	615	113	305	226	1595	25
	1996	473	40	190	180	938	173	407	345	2234	23
Independent Systems	1989	30	9	43	31	127	11	24	5	241	39
Uses Paldang & about	1992	137	15	71	44	276	50	36	25	502	25
20% of Incheon 9]	1996	204	20	95	53	410	74	48	37	718	24
Euijeongbu Intake	1989	38	9	43	34	74		38	7	195	
	1992	59	12	57	52	114		56	11	290	
	1996	79	12	57	68	163		75	14	367	
Euijeongbu	1989	38	14	66	30	158	14	11	28	306	36
Treatment Plant and	1992	59	20	95	48	245	22	16	43	468	35
Booster Pumping St.	1996	79	22	104	62	328	29	22	58	603	34
All Systems	1989	390	107	508	624	2548	136	545	327	4687	33
	1992	821	142	674	914	5195	287	817	648	8535	28
	1996	1214	159	754	1142	7658	423	1080	957	12022	27

1] Source: Nihon Suido-KECC Feasibility Study and appraisal estimates.
2] From Annex 3. Water demand (thousand metric tons per day) at intakes is increased by 5% because of water losses during treatment.
3] Total expenses average won 13,000 per day per person.
4] Demand charges of W2953/KW/month; Power charges of W44.05 per kwh. 80% load factor.
5] Chemicals are estimated at W 1.0 per mt.
6] Estimated as a percentage of the value of each system, increasing with age from 0.3% to 0.6.% (value for existing systems).
7] Other expenses, including a share of central administration estimated at W.54 per mt for the intakes and W3 per mt for treatment plants.
8] The expenses in each system include their share of the intake and raw transmission expenses.
9] 30% of the cost of Incheon system, excluding the treatment plant (or 20% of total cost) is allocated to raw water.

26-Nov-84

KOREA - METROPOLITAN REGION WATER SUPPLY PROJECT

INTERNAL RATE OF RETURN (IRR) BASED ON BULK WATER TARIFFS

(Million Won - Prices of January 1985)

YEAR	PROJECT COSTS: PROJECT INVESTMENT 1]	OPERATIONAL COSTS	INVESTMENT INCHEON & INDEPEND. TREATMENT PLANT 2]	OPERATION INCHEON & INDEPEND. TREATMENT PLANT 2]	TOTAL COST	NON-PROJECT COST (Controls, half intake tunnels) 3]	PROJECT BENEFITS: WATER SOLD INDEPEND. SYSTEMS MILL.TONS 4]	AVERAGE WATER TARIFF WON/TON 5]	REVENUES INDEPEND. SYSTEMS	TREATED WATER SOLD MILL.TONS 6]	TREATED WATER TARIFF WON/TON 5]	TREATED WATER REVENUES	TOTAL BENEFITS	NET BENEFITS
1985	27676		8500		36176								0	-36176
1986	49966		8500		58466	189							189	-58277
1987	51718		8500		58218	1364							1364	-56854
1988	33422		8500		39922	1927							1927	-37995
1989		3486		1201	4687		11.0	81.8	896	125.6	84.0	10547	11443	6756
1990		4276		1446	5722		25.8	81.8	2120	164.6	84.0	13828	15948	10225
1991		5245		1741	6986	8804	44.2	81.8	3613	208.4	84.0	17507	29924	22938
1992		6439		2097	8535	8804	50.0	81.8	4090	236.2	84.0	19837	32732	24197
1993		7014		2284	9298		56.2	81.8	4598	265.7	84.0	22320	26918	17620
1994		7642		2488	10130		62.8	81.8	5135	296.7	84.0	24927	30062	19932
1995		8325		2710	11035		69.4	81.8	5673	324.1	84.0	27226	32899	21864
1996		9070		2952	12022		76.7	81.8	6270	341.6	84.0	28698	34968	22946
1997		9161		2981	12142		85.8	81.8	7016	388.7	84.0	32653	39669	27527
1998		9161		2981	12142		85.8	81.8	7016	388.7	84.0	32653	39669	27527
1999		9161		2981	12142		85.8	81.8	7016	388.7	84.0	32653	39669	27527
2000-2028		9161		2981	12142		85.8	81.8	7016	388.7	84.0	32653	39669	27527

THE INTERNAL RATE OF RETURN (IRR) IS: 9.9%

SENSITIVITY ANALYSIS:

	Internal Rate of Return
Benefits reduced by 10%	8.7%
Investment cost increased by 10%	9.1%
Two years construction delay	8.6%
Investments and operational expenses increased by 15%	8.3%

MARGINAL COST ANALYSIS FOR TREATED WATER

Discount rate	PRESENT VALUES OF: Investment Mill. W	Operational Expenses Mill. W	Total Expenses Mill. W	% Investment on Total	Volume Sold Mill. mt	MARGINAL COST: Investment W / mt	Total W / mt
10%	150561	65927	216488	70%	2435	61.8	88.9
8%	157488	89060	246526	64%	3316	47.5	74.3
5%	166805	149468	316272	53%	5633	30.0	56.5

1] In 1985 prices, including physical contingencies, but excluding taxes and institutional building components.
2] The treatment plant for Incheon, Bucheon and Anyang is budgeted at W28,000 million, and the treatment facilities for the independent systems (Anyang, Euiwang, Dongbu and Banweol) is estimated at W11,000 million. Operation is included in Table 1.
3] Includes the value of tunnels and intakes, which are sized for twice the capacity (2.6 million mtpd) for a second stage by 1991-92. The savings on the construction of the second stage at that time, assumed in 1991-92, would exceed half of the tunnel cost. Half of the value of the controls systems at Paldang, which would be the central control for the two existing systems, is also deducted between 1986-88.
4] From Annex 3
5] Average water tariff for treated water, after the 10% increase by end of 1984
6] From Annex 3. Includes the Incheon, Seongnang and Euijeongbu systems.

26-Nov-84

KOREA - METROPOLITAN REGION WATER SUPPLY PROJECT

ECONOMIC RATE OF RETURN (ERR) BASED ON RETAIL WATER TARIFFS

(Million Won - Prices of January 1985)

	TOTAL COSTS					PROJECT BENEFITS						OTHER BENEFITS			
	BULK WATER		DISTRIBUTION SYSTEM												
YEAR	NET PROJECT INVEST MENT 1]	OPERA-TIONAL COSTS 2]	NETWORKS AND STORAGE 3]	INCRE-MENTAL OPERATION & ADMI-TRATION 4]	TOTAL COST	COSTS NOT FOR PROJECT (Controls, half intake tunnels) 5]	TOTAL BULK WATER SOLD MILL.TONS 6]	RETAIL WATER SOLD MILL.TONS 7]	RETAIL WATER TARIFF WON/TON 8]	WATER REVENUES W MILL.	NET BENEFITS	INCRE-MENTAL POPU-LATION SERVED 1000	NEW HOUSE HOLDS IN EACH YEAR 9]	INCREASE IN REAL ESTATE VALUE 10]	NE BENEF INCLU INCRE REAL VAL
1985	36176				36176	0					-36176				-36
1986	56466				56466	189					-56277				-56
1987	59218		20000		79218	1364					-76854				-76
1988	39922		20000		59922	1927					-57895				-57
1989		4667	20000	4993	29670	0	136.5	99.7	238	23677	-5992	462	103	41067	35
1990		5722		6954	12676	0	190.5	139.1	238	33047	20371	780	71	28267	48
1991		6886		9219	16205	8804	252.6	184.4	238	43809	36408	1129	78	31022	67
1992		8535		10445	18980	8804	288.2	208.9	238	49634	39458	1341	47	18844	58
1993		9298		11750	21048	0	321.9	235.0	238	55938	34789	1562	48	19844	54
1994		10130		13123	23252	0	356.5	262.5	238	62356	39107	1782	51	20444	59
1995		11035		14362	25397	0	393.5	287.2	238	68247	42850	2031	53	21244	64
1996		12022		15268	27289	0	418.3	305.4	238	72552	45262	2281	58	22222	67
1997		12142		17319	29461	0	474.5	346.4	238	82301	52840	2580	66	26578	79
1998		12142		17319	29461	0	474.5	346.4	238	82301	52840	2580	0	0	52
1999		12142		17319	29461	0	474.5	346.4	238	82301	52840	2580	0	0	52
0-2028		12142		17319	29461	0	474.5	346.4	238	82301	52840	2580	0	0	52

THE ECONOMIC RATE OF RETURN IS: 13.5%

SENSITIVITY ANALYSIS:	Economic Rate of Return
Benefits reduced 10%	11.6%
Investment cost increased 10%	12.5%
Two years construction delay	13.0%
Investments and operational expenses increased by 15%	11.3%
Including the estimated increase in real estate values	18.6%

1] From Table 2, total bulk water investments to produce treated water.

2] From Table 2, total operational expenses for bulk, treated water.

3] From complementary works Annex 7, excluding reservoir and distribution works unrelated to the project, and the treatment plants which have already being included in the investment.

4] Based on actual expenses in the project municipalities (Annex 1, Table 3), and cost breakdowns for Seoul, Incheon and Euijeongbu. The cost of raw water and chemicals is already included in the operational expenses. Power expenses would be lower in most cities since water would be provided by gravity, and are estimated at W20 per mt. Wages and administration are estimated at W 20 per mt, excluding the share for treatment plants and considering economies of scale. Materials and maintenance are estimated at W10 per mt. The total estimated cost is W50 per mt. This represents 80% of the total operational cost for Seoul (W92 per mt), excluding the cost of raw water purchased from ISWACO (W28 per mt).

5] Includes the value of tunnels and intakes, which are sized for twice the capacity (2.8 million mtpd) for a second stage by 1991-92. The savings on the construction of the second stage at that time, assumed in 1991-92, would exceed half of the tunnel cost. Half of the value of the controls systems at Paldang, which would be the central control for the two existing systems, is also deducted between 1988-89.

6] From Annex 3

7] Excluding unaccounting-for water averaging 27%

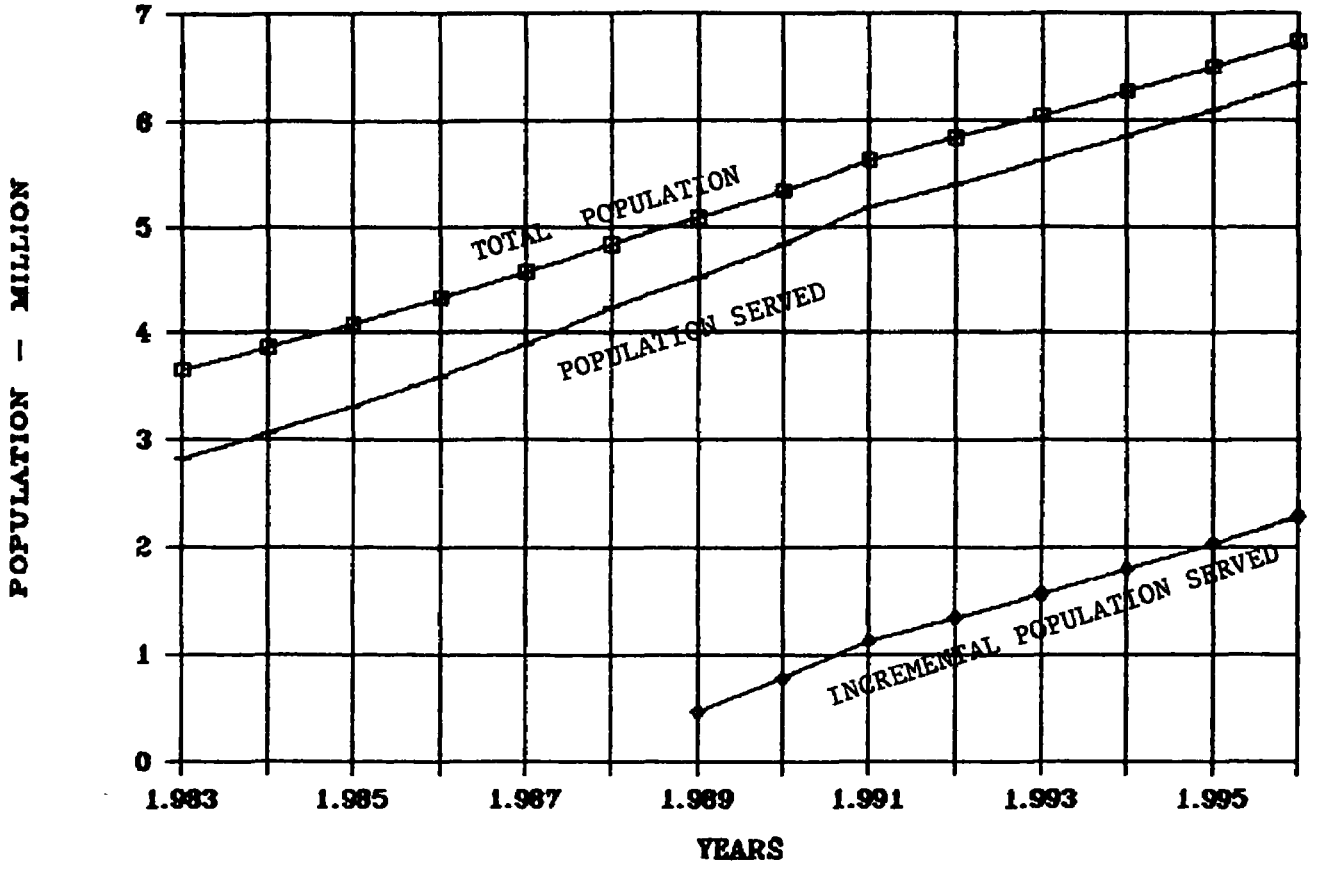
8] Average (W220 per mt) of the 1983 tariffs in Incheon (W227 per mt) and Bucheon (W213 per mt), the main consumers in the project. Adjusted 8% to express it in 1985 prices.

9] The number of new households is based in the incremental population served divided by 4.5 persons per household.

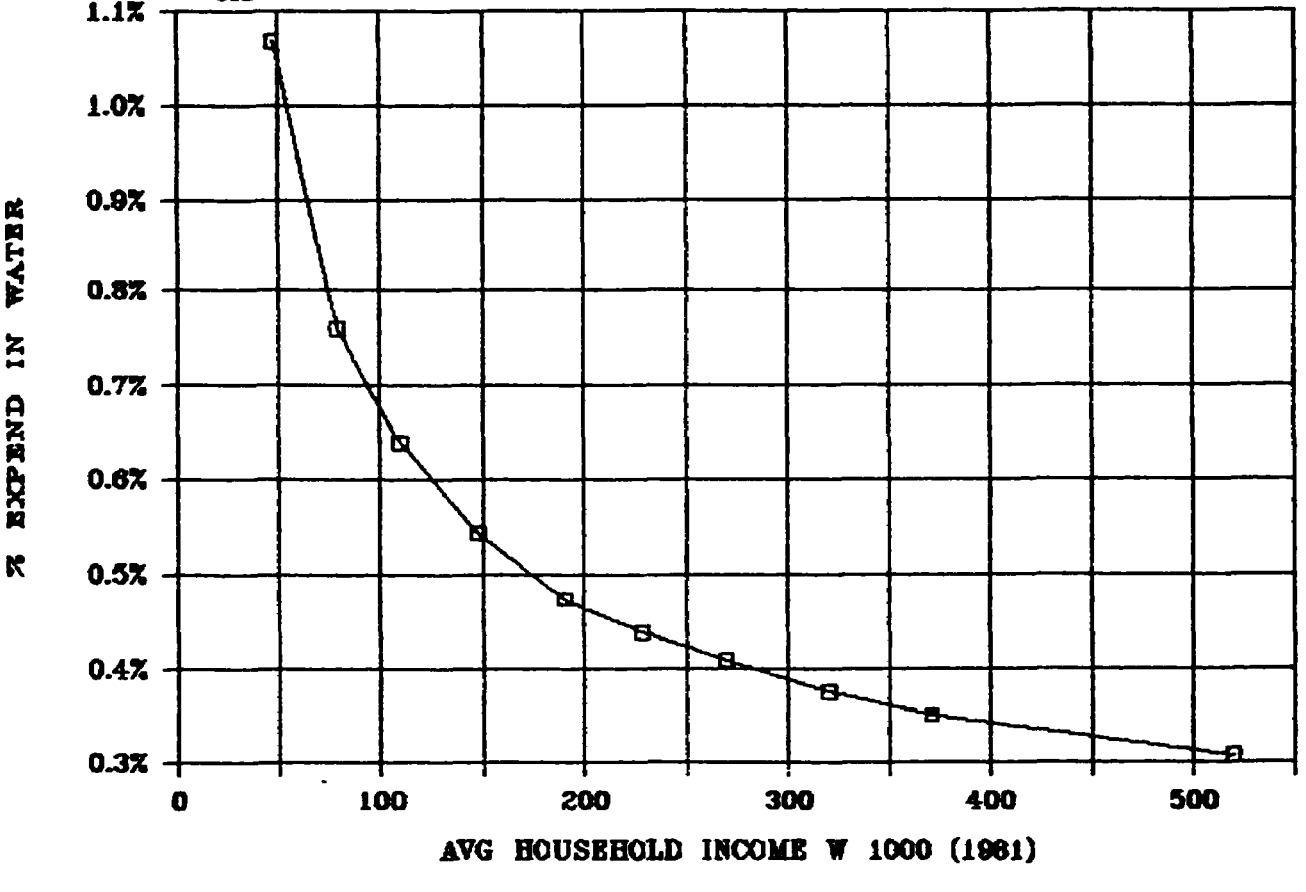
10] When piped water is available high rise construction become feasible and the price of land and real estate would increase. A conservative estimate of the present value of this increase in value is W400,000 ($500) per household, equivalent to 4% of the price of a low income house (W10,000,000).

Nov-84

GRAPH 1 POPULATION IN PROJECT MUNICIPALITIES



GRAPH 2 WATER AS % OF HOUSEHOLD EXPENDITURES



KOREA

METROPOLITAN REGION WATER SUPPLY PROJECT, METROPOLITAN WATER SUPPLY

Assumptions for Financial Projections

Inflation

1. Project cost tables assume that foreign price increases would be 8% p.a. in 1985, and 9% p.a. between 1986 and 1988. Local inflation in 1983 and 1984 has been only about 3%. Government efforts to curtail inflation are likely to hold inflation at these levels, in which case exchange rate adjustments may be used to, on the average, maintain the "purchasing power parity" with international prices. The projections assume that the local inflation would be about 2.5% in 1985 and 5.5% thereafter. The exchange rate for 1985 is assumed at W 800 per US dollar.

Financial Projections

2. The financial projections use a computer program developed by the appraisal team using Lotus 1-2-3. Only the main financial statements (Table 1 - Income, Table 2 - Flow of Funds, Table 3 - Balance, Table 4 - Financial Plan and Table 5 - Monitoring Indicators) are included in this report (Annex 8 for the Water Division and Annex 9 for the Dams Division). Additional tables (available in the Project File) provide details on all the assumptions and intermediate results regarding demand, fixed assets and revaluation, debt service, operational expenses, tariffs and revenues, etc. Therefore only the main assumptions are explained here.

Assets Revaluation

3. Korean regulations allow for the revaluation of fixed assets when their estimated value exceeds the book value by 25% or more. Under the Second Water Supply Project, ISWACO's Water and Dams assets should be revalued before December 31, 1984, and be revalued annually until the next formal revaluation, using 85% of the wholesale price increases as a conservative proxy for the price increase of fixed assets. The fixed assets of the Dams Division were revalued in 1983, doubling their book value. The assets of the Water Division are also being revalued, but their revaluation would be only about 20%, since most of these assets have been in operation for only a few years. The first two metropolitan systems (which represent 85% of the value of the fixed assets of this Division), were completed in 1979 and 1981 and the Gumi system in 1983, and inflation in Korea has been low during recent years. The financial projections use these revalued or estimated revalued fixed assets and depreciation. In 1985 Chungju Dam would only be partially in operation (6 months). Furthermore, since the reservoir would not be full, and water levels would be low, power generated is expected to be less than half the installed capacity. Under these conditions it would be unfair to ask for a full return on its assets. Only about 70% of Chungju Dam assets are assumed to enter into operation in 1985, with the remaining entering in 1986.

Geum Gang System

8. Under the new Public Enterprise Law (para. 4.08), ISWACO is making an effort to increase its management efficiency and profitability. Because of the above concerns ISWACO does not want to take over the operation of the Geum Gang regional system, which is expected to be completed by January 1985. Initial revenues may not even cover power expenses (partly because of overdesign). In the past, MOC has constructed a few water supply projects, which were not financially viable, and after construction transferred them to ISWACO for operation. ISWACO has hired the Korean Industrial Development Institute to study this problem and recommend conditions, tariffs and/or subsidies under which the Geum Gang could be operated by the beneficiary cities or by ISWACO. Therefore the projections exclude the Geum Gang system, although the effect of including it, without any subsidies, is included in additional financial projections available in the Project File. If ISWACO operates this system, the Bank should consider how the fixed assets and depreciation of this particular system (for which at present the demand and expenditures are only rough estimates) would be included in the rate of return calculation for purposes of the loan covenant (para. 5.07). Higher general tariff increases (about 10%) or special surcharges on the water sold on this system may be needed to achieve a 4% rate of return. Since the high cost of this system is partly due to demand errors the Bank should examine if it is justifiable for ISWACO to seek a full return on these assets, or only a partial return until the Geum Gang demand is higher.

Dams Division

9. The Dams Division includes the total operations of the dams, which ISWACO analyzes separately for: (a) water rights (water abstracted from rivers regulated by dams built by ISWACO), both for municipal and industrial use; (b) power generated by ISWACO and sold in bulk to KEPCO; and (c) water used for irrigation. When each dam is completed, a detailed economic analysis is made to allocate its cost to the beneficiaries (water rights, power, irrigation, flood control, traffic or roads, land reclamation, etc). The cost is allocated to each component using the lower of the benefits or the alternative cost for each component. The cost allocation for flood control and 70% of the cost allocation for irrigation are financed by Government grants, and are not included in ISWACO's fixed assets. In practice, ISWACO has not been able to collect revenues from the farmers (since the Ministry of Agriculture wants to subsidize food production), and the operational expenses for irrigation and flood control are now being charged to the other services.

10. Detailed demand projections for the sales of power, water rights and irrigation water in each dam under operation or construction and their respective charges and tariffs are presented in Table 10 of the detailed financial projections for this Division (available in Project File). The Chungju Dam is expected to start partial generation in June 1985, and by 1986 would increase by 138% the power presently generated by ISWACO in its other three dams (Andong, Soyang and Daecheong). The power generated by ISWACO is cheaper than the cost to KEPCO of its oil, gas or nuclear generation; therefore the full power capacity would be used as soon as it is available.

11. By 1988 the operating expenses, other than depreciation, represent only 12% of the revenues of the Dams Division. The remaining 88% of the revenues cover depreciation (33%), and return on capital (55%). About 47% of the operating expenses are for personnel. These expenses would double upon the completion of the Chungju Dam. Additional provisions for staff and other expenses are included upon completion of each of the other dams under construction: Hapcheon and the Nagdong Barrage in 1988 and Juam by 1990. Power expenses are to pump-back water at Andong during non-peak hours, to be used for generation during peak hours. Materials costs are forecast based on the new assets entering into operation.

Tariffs and Charges

12. Charges in the Water Division include basic charges for contracted water, consumption charges for the water used, and excess charges for water used above the contracted volume. Since the charges for excessive water consumption are more than four times those for water used, the average rate fluctuates and may actually be lower when the volume contracted increases (e.g. between 1983-84).

13. Power charges in the Dam Division are not for each dam. Government assigns a rate of return for the value of assets for power (para. 9) equal to the weighted average of the interest on the loans used to finance each dam. For Chungju Dam the rate of return using this system is estimated at 6.3% and the corresponding power rate at W33.7 per Kwh.

Flow of Funds

14. The Dams Division has investments of about $1 million per day in 1984, and a total projected investment of $1,080 million during 1984-88 (Annex 9, Table 4). These investments are financed by several foreign loans (including Bank Loans 1666-KO and 2350-KO), three loans from OECF, several loans from KDB and the Oil Fund and Government contributions. These are summarized in Annex 9, Table 2, and further details on terms and conditions of these loans are given in Table 8 of the financial projections for this Division (available in Project File). The investments, loans and contributions included are based on loans already signed or financial plans approved by the Government. Land reclaimed by the Nagdong Barrage Project would be sold between 1987 and 1989 and would largely improve the cash flow of this Division. MOC is doing feasibility studies for the construction of another five dams. However, no priorities or schedules have been approved, and detailed cost estimates are not available. ISWACO is now looking very critically at these new projects, requiring them to have a rate of return of at least 10% to be accepted. Tentative investments of $115 million, fully internally generated, have been included between 1989 and 1991 as a contingency for some of these projects.

15. Accounts receivable are about one month of the amounts billed. Other fixed assets include assets which are not included in the rate of return calculation (para. 9). Amounts payable to contractors represents one twelfth of the annual capital expenditures.

KOREA

METROPOLITAN REGION WATER SUPPLY PROJECT
STUDY OF ISWACO'S BULK WATER TARIFFS

Draft Terms of Reference

Background

1. The Government of Korea has an ambitious program to expand water supply and serve the whole population by the year 1990. In addition, the accelerated development of Korea's industrial, manufacturing and agricultural sectors, coupled with extremely high urbanization and rapid increases in per capita incomes, requires substantial increases in there per capita production of water. Since most of this demand is concentrated in the 50 largest cities, where the readily available and less costly sources of water have already been exploited, large and expensive investment programs for expansion of water supply production and distribution capacity are now being implemented. Even larger investments would be needed in the future to satisfy the projected water demands.

2. At the same time, this accelerated industrial and urban development has resulted in increased pollution of the main rivers in Korea, making it more difficult and expensive to use them as sources for potable water. This, and the exhaustion of the water resources in the vicinities of each municipality, have created the need to develop regional water supply projects, operated by the Industrial Sites and Water Development Corporation (ISWACO) to serve groups of municipalities. About 10 of these regional schemes are now in operation and several more (including river improvement projects) are being planned. Each regional system provides water in bulk to groups of municipalities, either raw (untreated) or treated, through long transmission pipelines and requires expensive pumping. The development of additional reliable water sources would also require the construction of large dams, which would store water during the rainy season from July to September (which accounts for two thirds of the annual precipitation of 1,160mm). Such dams are becoming increasingly expensive due to the shortage of suitable dam sites, the flooding of scarce agricultural land, and increasing land and compensation costs.

3. The Government has realized that the limited availability of water resources is becoming a critical constraint for the development of Korea. In fact, the surface water runoff in Korea is only about 1,700 cubic meters per person, or about 40% of the water runoff in a densely populated country like Japan, and only one tenth of the per capita runoff in the United States. Therefore, while plans for construction of additional dams, river improvement projects and expensive regional systems are underway, increasing attention is being given by the Government to the conservation of water resources. This has resulted in some efforts to coordinate water resource allocation, planning and conservation, and the implementation of leak detection and control programs to reduce water lost in the distribution systems.

4. However, conservation programs like leak detection are not a one-time operation. Unless the municipalities implement and continuously monitor such programs, misused, unmetered, wasted or leaked water from the distribution networks could represent up to half of the water supplied (as is the case now in Seoul City). Incentives are therefore required for the municipalities to conserve water and control leakage. One strategy to achieve this would be provided by setting meaningful levels of bulk water tariffs, as proposed under this study. These tariffs would in turn be reflected in the retail water tariffs, providing incentives to each family to reduce water wastage and unnecessary water consumption, and promote its efficient use. This is very important considering that under present projections each family of five persons uses 450 liters per capita per day (including overall industrial and commercial use, and unaccounted-for-water), and would require, on the average, 820 metric tons of water per year. The implementation of appropriate bulk water tariffs would have a large impact on reducing excessive and wasteful water use, and reduce the need for additional investments. This could eventually result in lower water tariffs for all.

5. The actual cost of water can vary widely even between neighboring municipalities (for example, because of the differences in the pumping energy, the quality of the water sources, the availability of underground sources, etc.). Excluding land, water is the only real "local resource", which can only be imported or exported, at a feasible price, over relatively short distances. However, the same bulk water tariffs are being applied to all municipalities in Korea at present. This has some favorable elements: cross subsidization, administrative simplicity, and political acceptance. However, since the cost of providing water is extremely high in some areas (for example in some coastal regions), the subsidy element may be counterproductive, and could promote excessive industrial, commercial and residential water consumption in areas where it is too expensive to provide additional supply. Excessive subsidies in such areas may create development problems in the near future. The rationale for uniform tariffs or other tariff alternatives needs to be studied. It is therefore important to analyze the cost of water for each independent regional project, and provide recommendations on pricing policies and the advantages or disadvantages of a policy of equal prices, and of other alternatives, like surcharges in zones where the water is too expensive, or the provision of basic water needs (perhaps 50 liters per day multiplied by the total population in each city) at a subsidized rate, with the additional water supply being provided at its real cost.

6. At present there is no clear analysis of the rationale for the differential in pricing between raw and treated water. The main cost in some of the regional systems (Metropolitan Region) is the extensive pipelines and large pumping expenditures; generally water is of such good quality that it requires only very simple treatment or filtering and chlorination. Therefore the capital and operational expenditures for water treatment would only add about 30% to the cost of raw water. However the present tariffs for bulk treated water are more than twice the tariffs for bulk raw water. This creates disincentives for the purchase of treated water by the municipalities. In this situation municipalities prefer to have their own treatment plants, which results in duplicated and inefficient investments, while the capacity of regional systems may not be fully utilized. Therefore,

it is important to establish the optimal level for the raw and treated water charges which would reduce or eliminate these problems. Moreover most of the present charges are fixed (based on the contracted volume of water), while actual charges for the water used are small (the fixed charges are almost 10 times the variable charges for treated water). This seems difficult to justify on economic grounds.

7. ISWACO has commissioned a tariff study with the Korean Industrial Development Institute (KID), the main emphasis of which is the financial impact on ISWACO of the Geum Gang system. These Terms of Reference expand the scope of the study, and look for a tariff policy that would be acceptable to the Government, achieve the social and economic objectives of providing water services, promote conservation and provide a satisfactory financial situation for ISWACO.

Objective

8. The main objective is to expand the coverage of the tariff study being undertaken by KIDI to:

(a) promote the efficient use and conservation of expensive water resources through reasonable pricing policies that would reduce unnecessary demand or would help to finance the construction of additional capacity;

(b) help Government to formulate policy, criteria and implementation guidelines for setting bulk water tariffs both for raw and treated water;

(c) promote balanced and sustainable industrial and commercial growth, based on cost recovery of the water services provided;

(d) reduce unnecessary or counterproductive subsidies between water supply systems; and

(e) improve the tariff structure, achieving a better balance between fixed and variable charges, and introducing simple criteria that would allow subsidies or low prices for basic consumption but discourage water wastage.

Scope of Work and Execution of the Study

9. The study should analyze the cost of bulk water provided by ISWACO in each regional system, and provide recommendations for pricing bulk-provided raw and treated water. It should also analyze the regional differences in the cost of water supply and provide advice on the advantages or disadvantages of a uniform pricing policy and alternatives to this policy. The study should consider: the cost to the economy of meeting the increasing demand for water (and corresponding sewage disposal), the need to promote a balanced development of the country, ISWACO's requirements to help finance additional capacity and to cover the operation and debt service of existing systems, and other social and economic considerations. The study should recommend a policy

and well-defined criteria to set the average water charges (which should be simple to implement and adapt later to changes in costs, demand or inflation), and an improved tariff structure that would be acceptable on social and economic grounds.

10. The consultant should also use this policy and criteria to recommend to the Government and ISWACO specific levels for raw and treated water charges. The study would be implemented by ISWACO in coordination with the Economic Planning (EPB) and the Ministry of Construction (MOC), and a draft copy of the study would be presented to the Bank for comments.

11. The scope of work includes the following activities:

(a) gather data, including the review of capital and operating expenses, for raw and treated water in the different regional systems and the analysis of proposed investment plans in new regional systems;

(b) analyze ISWACO's financial obligations and commitments, and its present and forecasted financial statements for water services under the present level of charges;

(c) analyze policy options regarding the pricing of bulk water services (including long-term marginal pricing), their advantages or disadvantages,and their financial, economic and social implications and consequences;

(d) make detailed analysis of the policy of uniform charges at the national level, its advantages or disadvantages, the impact on balanced development of the country, and the justification and magnitude of cross-subsidies between water users;

(e) recommend policy options for water pricing which would address the disadvantages of present policies and would be consistent with national policies and priorities; and

(f) propose a revised tariff structure for raw and treated water.

12. The study would be coordinated with EPB's Infrastructure Planning and Price Divisions. The conclusion of the draft study would be reviewed by all interested parties (para. 10). Based on comments received, the consultant should complete the study and provide final recommendations for bulk water pricing policies. The consultant should then apply the recommended policies to the specific data of the regional systems, and recommend raw and treated water charges. Financial alternatives would then be examined to assess the impact of the recommended charges, not only on ISWACO's financial viability but also on the affordability of water to end-users, the effect on demand, and the economic and social implications of the recommended charges.

13. The final report should include ISWACO's financial projections between 1983 and 1992 under the alternative policy options considered, the impact on water demand and investments, the advantages or disadvantages of all the options considered, a revised tariff structure, and a clear methodology

that could be used to implement the recommended tariff policy if the demand, inflation, or investments were changed.

ANNEX 14

KOREA

METROPOLITAN REGION WATER SUPPLY PROJECT

Documents Available in the Project File

1. Mission Working Papers

(a) Original and revised water demand.
(b) Finacial projections for ISWACO's Water Division.
(c) Financial projections for ISWACO's Dams Division.
(d) Economic and social analysis.
(e) Seoul's water and sewerage data.

2. Studies and other documents

(a) KECC and Nihon Suido. Master Plan and Feasibility study for the Metropolitan Water Supply Project (main report and three annexes). June 1983.

(b) KECC and Nihon Suido. Inception Reports, Metropolitan Region Water Supply Project. (March 1984).

(c) KECC and Nihon Suido. Interim Design Report (June 1984).

(d) ISWACO's Water Management Annual Report (1983).

(e) Ministry of Home Affairs. Municipal Yearbook of Korea (1983).

(f) Ministry of Home Affairs. Financial Yearbook of Local Government (1983).

(g) The Bank of Korea, Financial Statement Analysis of Korean Companies (1983).

(h) Seoul Metropolitan Government. Statistical Yearbook (1983).

(i) Incheon City. Master Plan and Feasibility Study for Water Supply. June 1983.

(j) Incheon City. Evaluation of Water Treatment Alternatives (April 1984).

(k) Incheon City. Expansion of Bupyong Water Treatment Facility (May 1984).

KOREA
METROPOLITAN REGION WATER SUPPLY PROJECT
Ministries and Main Functions in the Water Supply and Sanitation Sector

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CHART 1

KOREA
METROPOLITAN REGION WATER SUPPLY PROJECT
ISWACO's Organization Chart

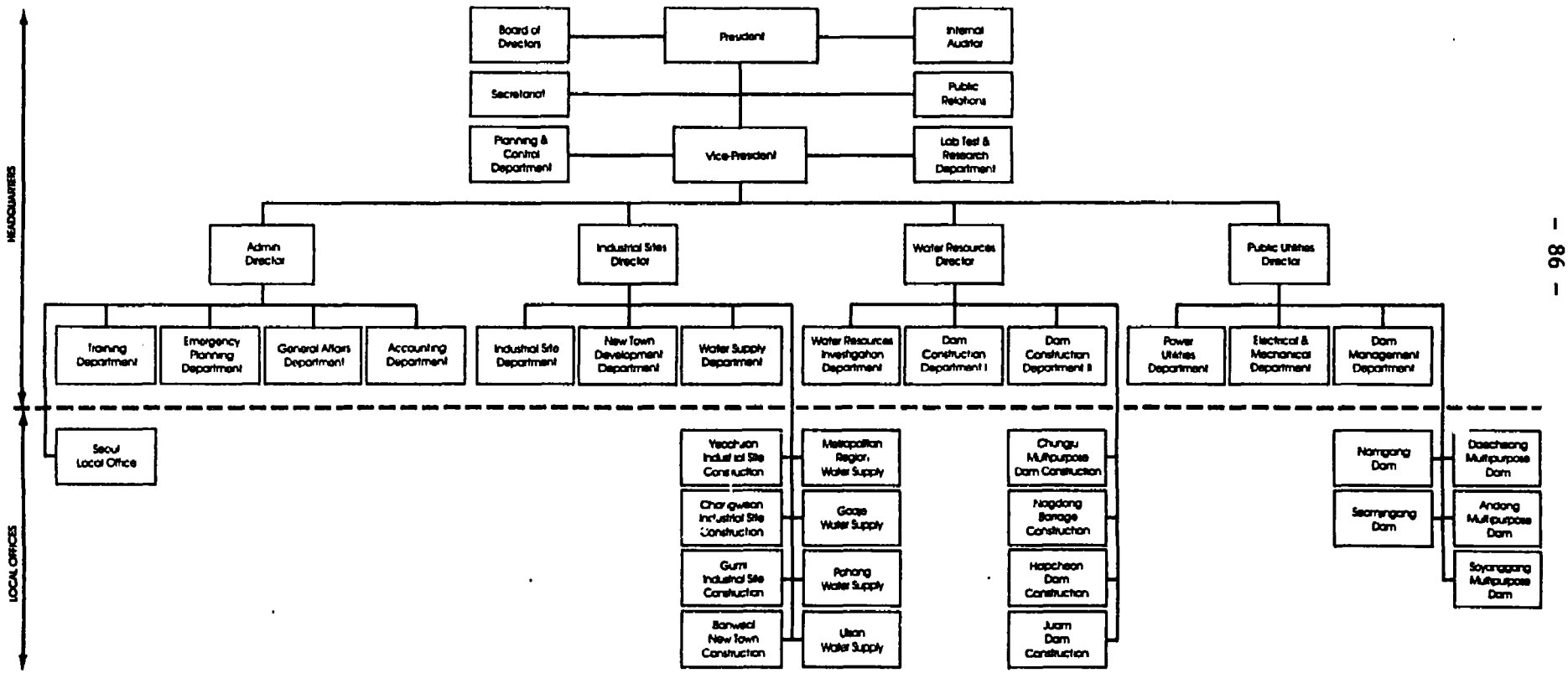

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CHART 2

KOREA

METROPOLITAN REGION WATER SUPPLY PROJECT

CONSTRUCTION SCHEDULE

CIVIL WORKS:	DESCRIPTION	COST MILLION 1985 $	1984 7 8 9 10 11 12	1985 1 2 3 4 5 6 7 8 9 10 11 12	1986 1 2 3 4 5 6 7 8 9 10 11 12	1987 1 2 3 4 5 6 7 8 9 10 11 12	1988 1 2 3 4 5 6 7 8 9 10 11 12
1) RAW WATER SYSTEM:	1,200,000 mtpd	39.1	BBBBAA				
Paldang Int.& Pump.Station	2,400,000 mtpd			==|==========30%|	==========65%|	==========90%|	===|100%
Paldang-Suseo Trans.Pipelines	Twin 11 km (2.2m dia)			==|==========20%|	==========55%|	==========85%|	=========|100%
Tunnels 1 to 3	6.2 km (3.8 m dia.)			==|==========20%|	==========55%|	==========85%|	=========|100%
2) INCHEON SYSTEM	560,000 mtpd	25.9		BBBBAA			
Main Transmission Pipe.	28 km (2.4/1.6 m dia.)			==========|5%|	==========45%|	==========80%|	=========|100%
Tunnels 4 to 6	6.5 km (3 m dia.)			==========|5%|	==========45%|	==========80%|	=========|100%
Booster Pumping Station					==========35%|	==========70%|	=========|100%
3) SEONGNAM SYSTEM:	405,000 mtpd	30.7		BBBBBAA			
Main Transmission Pipeline	48km (1.8/1.3 m dia.)			===|5%|	==========45%|	==========75%|	=========|100%
Treatment Plant & BPS	405,000 mtpd			===|5%|	==========45%|	==========75%|	=========|100%
4) EUIJEONGBU SYSTEM	100,000 mtpd	12.8		BBBBAA			
Intake & Pumping Station	2 ea (1.1m dia.)			==========|5%|	==========45%|	==========75%|	=========|100%
Water Treatment Plant	100,000 mtpd			==========|5%|	==========45%|	==========75%|	=========|100%
Booster Pumping Station					==========30%|	==========60%|	=========|100%
Main Transmission Pipeline	24 km (1.1/0.9 m dia.)			==========|5%|	==========45%|	==========75%|	=========|100%
Tunnel	1.0 km (2.0 m dia.)			==========|5%|	==========45%|	==========75%|	=========|100%
5) LAND ACQUIS. & COMPENSATION.	90 ha	9.9	========|	==========50%|	==========90%|	===|100%	

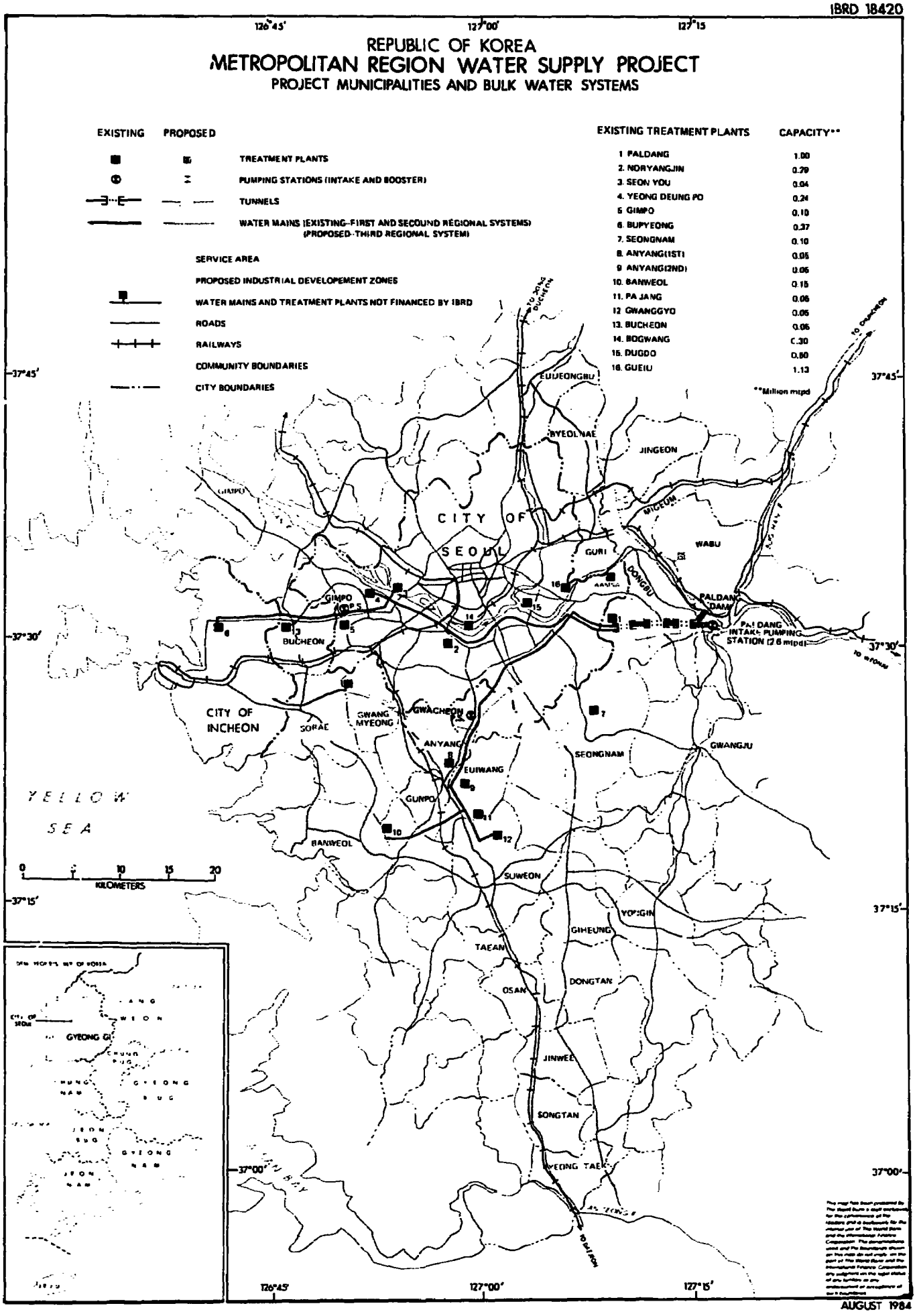
EQUIPMENT AND MATERIALS		COST MILLION 1985 $	1984 7 8 9 10 11 12	1985 1 2 3 4 5 6 7 8 9 10 11 12	1986 1 2 3 4 5 6 7 8 9 10 11 12	1987 1 2 3 4 5 6 7 8 9 10 11 12	1988 1 2 3 4 5 6 7 8 9 10 11 12
6) PIPES & FITTINGS		41.5	BBBBAA				
Raw Water System	22 km (2.2 m dia)	13.3		==========20%|	==========45%|	==========85%|	===|100%
Incheon System	28 km (2.4/1.6 m dia)	9.7		==========15%|	==========45%|	==========80%|	===|100%
Seongnam System	48 km (1.8/1.3 m dia)	15.1		BBBBAA==========|5%|	==========45%|	==========80%|	===|100%
Euijeongbu System	26 km (1.1/0.9 m dia)	3.6		==========|5%|	==========45%|	==========80%|	===|100%
7) PUMPS & MOTORS		4.1		BBBBAA			
Raw Water System	48, 250,000 mtpd	1.9			==========30%|	==========80%|	== |100%
Incheon System	40, 140,000 mtpd	0.7			==========30%|	==========80%|	== |100%
Seongnam System	40, 88,000 mtpd	0.9			==========30%|	==========80%|	== |100%
Euijeongbu System	30, 36,000 mtpd & 40 23,500 mtph	0.6			==========30%|	==========80%|	== |100%
8) ELECTRIC & SUBSTATION	1 lot.	5.9		BBBBAA			
Raw Water System		3.2			==========15%|	==========55%|	===|100%
Incheon System		0.3			==========15%|	==========55%|	===|100%
Seongnam System		1.1			==========15%|	==========55%|	===|100%
Euijeongbu System		1.3			==========15%|	==========55%|	===|100%
9) CONTROLS	1 lot.	12.5		BBBBAA			
Raw Water System		6.9			==========20%|	==========60%|	========= 100%
Incheon System		0.5			==========20%|	==========60%|	========= 100%
Seongnam System		2.1			==========20%|	==========60%|	========= 100%
Euijeongbu System		3.0			==========20%|	==========60%|	========= 100%
10) OTHER EQUIPMENT	1 lot.	8.5		BBBBAA			
Raw Water System		2.9			==========30%|	==========70%|	===|100%
Incheon System		1.1			==========30%|	==========70%|	===|100%
Seongnam System		2.9			==========30%|	==========70%|	===|100%
Euijeongbu System		1.6			==========30%|	==========70%|	===|100%
11) ENGINEERING & TECH.ASSIST.		5.7					
Project Administration		1.6	========|	==========25%|	==========50%|	==========80%|	==========|100%
Project Supervision		4.1	BBBAA==	==========25%|	==========50%|	==========80%|	==========|100%
Bulk Water Tariff Study		0.1		BBBBAA==========50%|	==========100%|		
TOTAL PROJECT		196.5		==========16%|	==========47%|	==========80%|	=========|100%

08-Jan-85

CHART 3

IBRD 18420

REPUBLIC OF KOREA
METROPOLITAN REGION WATER SUPPLY PROJECT
PROJECT MUNICIPALITIES AND BULK WATER SYSTEMS



AUGUST 1984